

ALASKA DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS ANNUAL REPORT



State of Alaska
Department of Natural Resources
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
ANNUAL REPORT 2000
www.dggs.dnr.state.ak.us

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State of Alaska

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Division of Geological & Geophysical Surveys

Milton A. Wiltse, State Geologist and Director

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•Division of Geological & Geophysical
Surveys

ATTN: Geologic Communications
794 University Avenue, Suite 200
Fairbanks, Alaska 99709-3645

•University of Alaska Anchorage Library

3211 Providence Drive
Anchorage, Alaska 99508

•Alaska Resource Library

3150 C Street, Suite 100
Anchorage, Alaska 99503

•Elmer E. Rasmuson Library

University of Alaska Fairbanks
Fairbanks, Alaska 99775-1005

•Alaska State Library

State Office Building, 8th Floor
333 Willoughby Avenue
Juneau, Alaska 99811-0571

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OREWORD

The Alaska Division of Geological and Geophysical Surveys (DGGs) annually reports its prior year's accomplishments, current activities, and plans for the future to the Alaska Legislature. This year we have decided to take advantage of the Internet to move the content of our annual briefing on-line (www.dggs.dnr.state.ak.us) so that more of Alaska's citizens can learn of the Division's program and how we apply geoscience to specific issues.

Geology has a tremendous impact on our lives in Alaska. Clearly, everyone is aware of the link between geology and the oil industry that sustains so much of the state's economy. Living in the "Last Frontier" state, Alaskans also are aware of the historical and resurgent importance of Alaska's geologic mineral endowment to our economy. In addition to being a source of economic wealth, however, our state's geology affects us in more subtle ways. Alaska has very real geologic hazards that can be mitigated if critical data and warning systems are in place prior to destructive events. Some health issues are influenced by geology. Transportation, urban development, coastal erosion, river—bank erosion, groundwater, agriculture, forestry, and a host of other sectors of our lives all are influenced by geology to various extents.

While focusing our programs on energy, mineral, and hazard mitigation issues, DGGs scientists generate data and information useful to the broader range of state geologic concerns. Much of this new information is captured in the comprehensive geologic maps created by our field teams. Good geologic and geophysical data can serve many purposes. Computer technology has made analysis of all kinds of geologic information more effective and provides tools for synthesizing previous work with current observations. Data collected today for one purpose will be used by other geologists now and in the future to solve problems that were not recognized as an objective of the project that generated them.

The better our geologic database is organized and the more accessible it is, the more valuable it becomes. Thus, within the current and proposed DGGs program there is a growing emphasis on the creation of a publicly accessible DGGs geologic database and information management system. We also are working with other state and federal agencies to build a network of linked natural resource agency data sources that will be available to the public. In their own way, these data management projects are as exciting as the geologic insights being worked out by our field teams.

DGGs is a dynamic agency. Our geologists and support staff come to work each day knowing that their work makes a difference in the lives of Alaskans. New scientific and information-management technologies are being adopted and new skills mastered throughout the Division. Learning never ceases here. Our Division is growing not in numbers of employees but in employee capability. It is an exciting time to be part of DGGs. I believe this year's annual report will convey to you why this is so.

Sincerely,



Milton A. Wiltse
State Geologist and Director

Division of Geological & Geophysical Surveys

Annual Report 2000

INTRODUCTION

LEGISLATIVE MISSION AND MEASURES STATEMENT

The following mission statement and accompanying measures are based upon the statutory mandates of AS 41.08 and the guidance of the Alaska State Legislature.

DEPARTMENT OF NATURAL RESOURCES

Mission: *Develop, Conserve, and Enhance Natural Resources for Present and Future Alaskans*

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

Mission: *Determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources, the locations and supplies of groundwater and construction material; and the potential geologic hazards to buildings, roads, bridges, and other installations and structures (AS 41.08.020)*

Activities

Effort

Business Processes

Outputs

33% Generate new geologic data and information that apply specifically to Alaska mineral and energy resources, construction materials, and geologic hazards

Studies, published papers, electronic publications, digital databases

65% Compile, analyze, and publish summary reports and maps that identify source areas for minerals, energy resources, and construction materials and provide for the mitigation of natural geologic hazards

Studies, published papers, digital databases

2% Help coordinate the geologic and archive activities of other state and federal agencies

Five-year priority list, Geologic Materials Center archives

Results (Outcomes)

- I. Encourage private-sector investment in ventures that will develop Alaska's mineral, oil and gas, coal, and construction materials
- II. Mitigate the adverse effects of naturally occurring geologic hazards on the economy of Alaska and the safety of Alaskans

Measures

1. Maintain the total value of Alaska's mineral industry at greater than \$1.0 billion dollars.
2. Acres of ground under private-sector mineral exploration.
3. Complete geophysical/geological mineral surveys of 1,000 square miles of Alaska land at a target scale of 1 inch = 1 mile reported by category.
4. New acres of ground explored by the private sector for oil and gas.
5. Numbers of users requesting information on the geology of Alaska from the DGGS web site.
6. Number of responses to requests for information or assistance relating to engineering geology or hazards in Alaska.

HISTORY

The present Division of Geological & Geophysical Surveys evolved from Alaska's Territorial Department of Mines. That heritage is reflected in the Division's ongoing commitment to the application of geology to improve the welfare of Alaska citizens. The name and mission of the Division were stabilized in 1972 with the passage of Alaska Statute AS 41.08.

Territorial Department of Mines, 1959
Division of Mines and Minerals, 1959-66
Division of Mines and Geology, 1966-70
Division of Geological Survey, 1970-72
Division of Geological & Geophysical Surveys, 1972-Present

LEADERSHIP

Seven qualified professional geoscientists have served as State Geologist:

Jim Williams, 1959-71
William Fackler, 1971-73
Donald Hartman, 1973-75
Ross G. Schaff, 1975-86
Robert B. Forbes, 1987-1990
Thomas E. Smith, 1991-1995
Milton A. Wiltse, 1995-Present

The State Geologist also serves as the Director of the Division of Geological & Geophysical Surveys within the Department of Natural Resources (DNR) and is appointed by the DNR Commissioner. Since the early 1970s, the State Geologists have been selected from lists of candidates prepared by the geological community and professional societies within Alaska—similar to the process by which judicial appointees are selected. The qualifications and responsibilities of the State Geologist and the mission of DGGS are defined by statute.

STATUTORY MANDATES

Alaska Statutes Sec. 41.08.010. Division of geological and geophysical surveys. There is established in the Department of Natural Resources a Division of geological and geophysical surveys under the direction of the state geologist. (1 ch 93 SLA 1972)

Sec. 41.08.015. State geologist. The commissioner of natural resources shall appoint the state geologist, who must be qualified by education and experience to direct the activities of the Division. (1 ch 93 SLA 1972)

Sec. 41.08.020. Powers and duties. (a) The state geologist shall conduct geological and geophysical surveys to determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources; the locations and supplies of groundwater and construction materials; the potential geologic hazards to buildings, roads, bridges and other installations and structures; and shall conduct such other surveys and investigations as will advance knowledge of the geology of Alaska. With the approval of the commissioner, the state geologist may acquire, by gift or purchase, geological and geophysical reports, surveys and similar information.

LOCATION

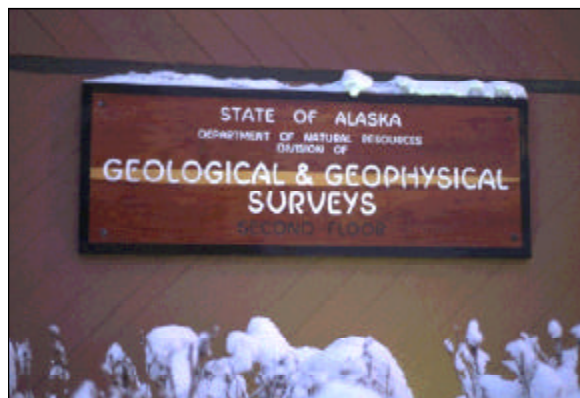
The Division's administrative headquarters and personnel were moved to Fairbanks in 1987. The close proximity of the Division to the earth science research laboratories of the University of Alaska Fairbanks campus has a strategic benefit to the DGGS program. University staff and students are important adjunct members of many DGGS project teams.

Current DGGS staff strength totals 28 professional and support personnel, plus seven student interns hired through the State of Alaska intern program.

DGGS operates a Geologic Materials Center in Eagle River, Alaska, staffed by one professional geologist.

ORGANIZATION

DGGS is one of seven Divisions within the Alaska Department of Natural Resources (fig. 1).



Department of Natural Resources Current Organizational Chart

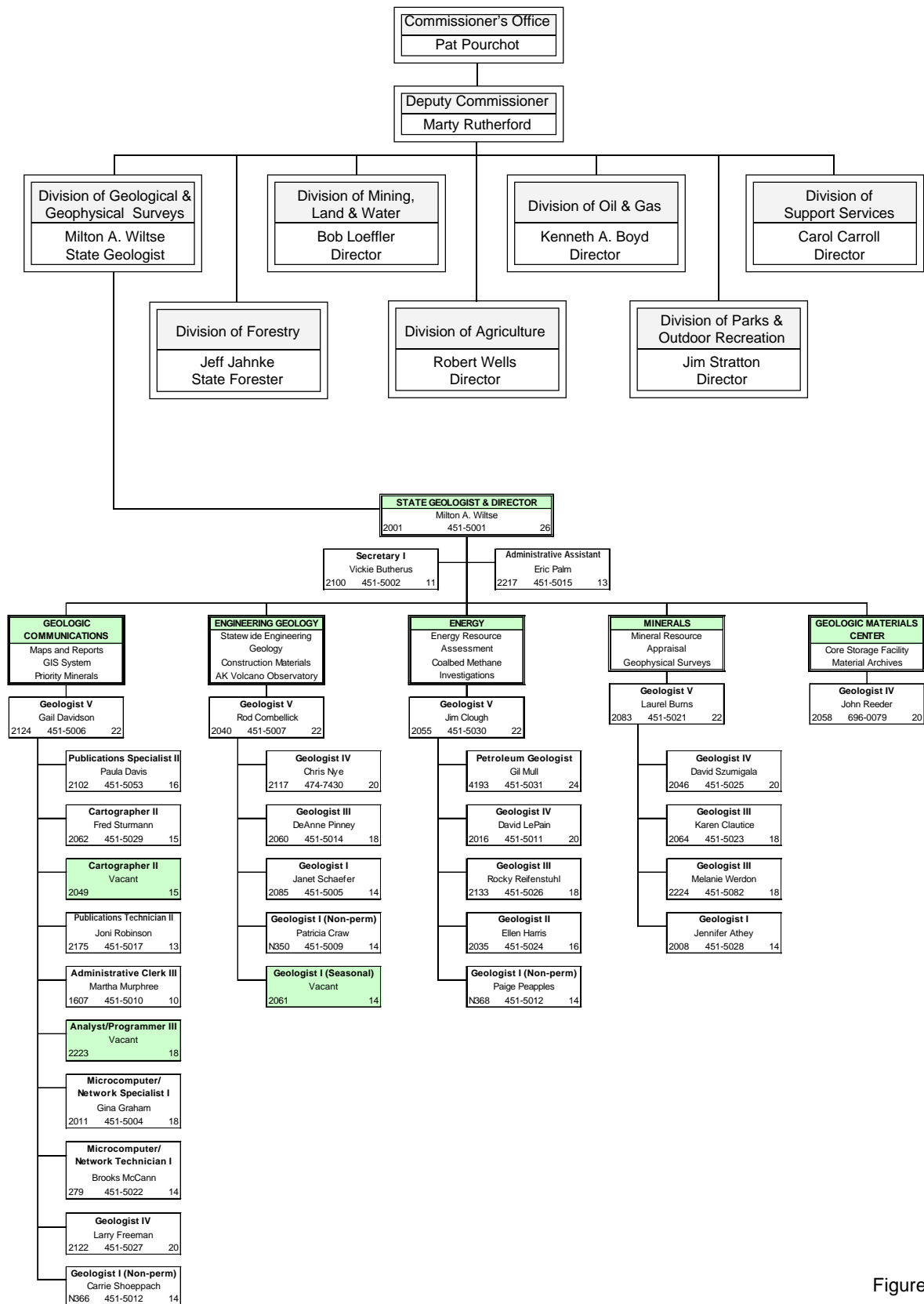


Figure 1.

Under the overall administration of the Director's Office, The Division of Geological & Geophysical Surveys is organized into four sections and the Geologic Materials Center:

The **Director's Office** provides strategic planning for the Division's programs to ensure that DGGs is meeting the needs of the public within the guidelines of AS 41.08.020, manages the Division's fiscal affairs, and provides personnel and clerical services. The Director acts as a liaison between the Division and local, state, federal, and private agencies; seeks out and encourages cooperative geologic programs of value to the state; and advises the Commissioner of the Department of Natural Resources about geologic issues.



The **Mineral Resources Section** collects, analyzes, and makes available information on the geologic and geophysical framework of Alaska as it pertains to the mineral resources of the state. Summary maps and reports illustrate the geology of the state's prospective mineral terranes and provide data on the location, type, and potential of the state's mineral resources. The Mineral Resources Section seeks to improve the success of mineral discovery in Alaska so that new employment opportunities are created for all Alaska citizens.



The **Energy Resources Section** generates new information about the geologic framework of frontier areas that may host undiscovered oil, gas, or coal resources. Summary maps and reports illustrate the geology of the state's prospective energy basins and provide data on the location, type, and potential of the state's energy resources. The Energy Resources Section's scope of activities includes work that seeks to identify local sources of energy for rural Alaska villages and work that seeks to improve the success of state-revenue-generating commercial oil exploration and development.





The **Engineering Geology Section** collects, analyzes, and compiles geologic data useful for engineering purposes. Surficial-geologic maps portray the distribution of sediment types and provide information on the sedimentary units, engineering properties, and usefulness as construction materials. Studies of major geologic hazards like earthquakes, volcanoes, and landslides result in reports outlining potential impacts on susceptible areas and expected frequencies of incidence occurrence.



The **Geologic Communications Section** has the primary responsibility for transferring Division-generated geologic information to the public and for maintaining and improving public access to DGGGS geologic information. Increased utilization of computer technology is resulting in faster preparation of maps and reports and a wider awareness of Alaska geologic information available at DGGGS. This section is coordinating the design of a computer-hosted database for the Division's digital and map-based geologic and geophysical data. The section responds each year to an estimated 2,500 public inquiries about geologic resources in Alaska.



The **Geologic Materials Center** is the state's single central repository for representative geologic samples of oil- and gas-related well cores and cuttings, mineral deposit core samples, and regional geologic voucher samples. These materials are routinely used by industry to enhance the effectiveness and success of private-sector energy, mineral, and exploration ventures. New materials are continuously acquired. Access to the materials at the GMC is free. To ensure that the value of the GMC holdings is maintained over time, any new data generated from privately funded analyses of the geologic materials stored there must be donated to the GMC database.

RELATIONSHIPS WITH OTHER STATE AGENCIES

DGGS provides other DNR agencies with routine analyses and reviews of various geologic issues such as hazards evaluations of pending oil lease tracts, competitive coal leases, geologic assessments of land trades, selections, or relinquishments, mineral potential, and construction materials availability. DGGS works closely with the State Pipeline Coordinator's Office when geotechnical information about future access corridors is needed.

We have an increasing amount of interaction with the Land Records Information System group in the DNR Support Services Division as more of our geologic data is compiled and organized in digital format amenable to merging with other land information. The

DGGS energy group often works with geologic personnel in the Division of Oil and Gas (DOG) on issues related to rural energy sources and in providing geologic control for the subsurface oil-related geologic analyses conducted by DOG. DGGS supplies the Division of Forestry with information about the mineral resource potential within state forests. Each year DGGS prepares an annual report on the status of Alaska's mineral industry in cooperation with the Division of Business Development of the Department of Community & Economic Development. DGGS works closely with Division of Emergency Services in the Department of Military and Veterans Affairs to design response scenarios for earthquake hazards events.

Funding to support work requested by other DNR agencies has mostly been drawn from our yearly general fund appropriation. For larger efforts, however, the intra-department work is supported by interagency fund transfers, Capital Improvement Project funding, or federal grants that supplement DGGS's general funds. We are not currently engaged in any major interagency cooperative DNR projects.

In summary, DGGS provides an ongoing geologic consulting service to other DNR divisions and line agencies of state government. Typically these activities occupy from 5 to 10 percent of our total effort. Over the last few years, interagency funding from other DNR divisions has been about one percent of our total budget.



RELATIONSHIPS WITH LOCAL GOVERNMENT

Most of the cooperative efforts implemented by DGGS with borough and municipal governments are conducted on a mutually beneficial but informal basis. Notable exceptions are the cooperative efforts with Wrangell and the Ketchikan Gateway Borough. The City of Wrangell transferred \$200,000 to DGGS to partially pay for an airborne geophysical survey of high-potential mineral lands near the city. Wrangell's \$200,000 was matched by \$300,000 from the U.S. Bureau of Land Management and an in-kind contribution of DGGS expertise to oversee the implementation of the geophysical surveys through the use of private-sector contractors. The Ketchikan Gateway Borough cooperative project was funded by contributions from the Borough, Sealaska Native Corporation, the State Mental Health Trust Land Office, the City of Thorne Bay, the community of Coffman Cove, and the U.S. Bureau of Land Management.

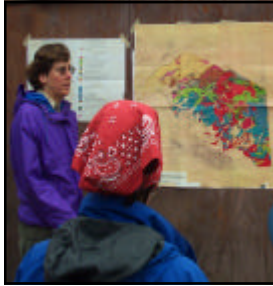
RELATIONSHIP WITH THE UNIVERSITY OF ALASKA

DGGS has had a long and productive professional association with the geoscientists and students in various departments of the University of Alaska. University of Alaska faculty work as project team members on many DGGS projects and provide special analytical skills for generating geochemical and radiometric-age data. University students employed as DNR/DGGS interns also are an important part of the DGGS work force. While working on current DGGS projects, the students learn a wide variety of geology-related skills ranging from conventional geologic mapping and sample preparation techniques to modern digital database creation and geographic information systems. DGGS and the University make frequent use of each other's libraries and specialized equipment.



RELATIONSHIPS WITH FEDERAL AGENCIES

DGGS has ongoing cooperative programs with the U.S. Geological Survey (USGS), the U.S. Bureau of Land Management (BLM), and the U.S. Department of Energy. Periodically, DGGS also engages in cooperative programs with the U.S. Minerals Management Service.



We are currently completing a cooperative program with BLM to upgrade the Alaska Geologic Materials Center in Eagle River. DGGS also receives federal funds in the form of matching grants for which we must compete nationally with other organizations on a yearly basis. In

the past we have been successful in securing funds to support mineral inventory mapping, surficial and earthquake hazards-related mapping, volcanic-hazards-related work and studies related to oil and gas potential in Cook Inlet and the North Slope. We are not, however, assured of yearly success for any of our federal grant proposals. These funds, therefore, sometimes complement but do not replace General Fund money.



ALASKA GEOLOGIC MAPPING ADVISORY BOARD

The Alaska Geologic Mapping Advisory Board guides DGGS in pursuing its goal of providing earth science information to the Alaskan public. A number of prominent leaders in the geological community with a variety of backgrounds and a broad spectrum of experience in Alaska have agreed to serve on the advisory board. The purpose of the board is multifold:

- To identify strategic geologic issues that need to be addressed by the state.
- To inquire into matters of community interest relating to Alaska geology.
- To provide a forum for collection and expression of opinions and recommendations relating to geologic investigation and mapping programs for Alaska.
- To make recommendations toward identifying Alaska's diverse resources and promoting an orderly and prudent inventory of those resources.

- To increase public awareness of the importance of geology to the state's economy and to the public's health and safety.
- To promote communication among the general public, other government agencies, private corporations, and other groups that have an interest in the geology and subsurface resources of Alaska.
- To facilitate cooperative agreements between DGGS and other agencies, professional organizations, and private enterprise to develop data repositories and enhance the state's resource inventory and engineering geology programs.
- To communicate with public officials as representatives of groups interested in the acquisition of Alaska geologic information.
- To enlist public support for statewide geologic resource inventories and engineering geology programs.

The board held its first meeting in Fairbanks on October 22, 1995, and meets at least three times a year to discuss state needs, review DGGS programs, and provide recommendations to the State Geologist. The members solicit and welcome comments and suggestions from the public concerning state needs and DGGS programs throughout the year.

Members of the board are:

Jim Rooney

R & M Consultants, representing the engineering geology and geotechnical community

James W. Rooney, P.E., is President of R&M Consultants, Incorporated, and an original partner of this Alaskan engineering firm that celebrated its thirtieth year in business in 1999.

Richard Glenn

Director of the North Slope Borough Department of Energy, representing the interests of northern Alaska

Richard Glenn is based in Barrow, Alaska, and has first-hand knowledge of many of the geoscience problems confronting the northern part of Alaska.

Curt Freeman

Avalon Development Corporation, representing the minerals industry

Curt Freeman is President of Avalon Development Corporation, a consulting mineral exploration firm based in Fairbanks, Alaska.

David Hite

Hite Consultants, representing the energy industry
Dr. David Hite is based in Anchorage, Alaska, and has extensive knowledge of the geologic issues associated with Alaska's oil industry.

Paul Layer

University of Alaska Fairbanks Geology and Geophysics Department, representing the academic community.

Dr. Paul W. Layer is an Associate Professor of Geophysics at the University of Alaska Fairbanks and is currently Head of the Department of Geology and Geophysics, a position he has held for 4 years.

DGGS FY01 PROGRAM OUTLINE

PROGRAM FOCUS

DGGS develops its strategic programs and project schedule through consultation with the many users of geologic information—state and federal agencies, the Federal Congressional Delegation, the Alaska State Legislature, professionals in the private sector, academia, and individual Alaska citizens. Their input to DGGS programs comes through the Alaska Geologic Mapping Advisory Board, liaison activities of the Director, and personal contact between DGGS staff and the above groups.

The FY01 DGGS program is focused primarily on projects designed to foster the creation of future Alaska jobs and revenue and the mitigation of adverse consequences arising from geologic hazards. To maintain general prosperity, Alaska must encourage major capital investment for job creation in the state. In the near future, much of the economy will continue to depend on developing the state's natural resources. Within that future, subsurface energy and mineral resources constitute the major portion of the state's wealth. Mitigating the effects of geologic hazards helps preserve public safety

and private investments by fostering sound design and construction practices.

The role of DGGS in state revenue generation and the maintenance of Alaska's economy is strategic. DGGS provides objective geologic data and information used by in-state, national, and international mineral and energy companies, construction companies, air carriers, other DNR agencies, Department of Law, Department of Community & Economic Development, Department of Transportation & Public Facilities, Division of Emergency Services, and the Federal Emergency Management Agency. DGGS geologists assist prospectors, mineral, oil, and gas explorationists, and others to explore for, discover, and develop Alaska's subsurface resources. DGGS is a central repository of Alaska geologic information and a primary source of information for mitigating geologic hazards (for example, volcanic hazards, coastal erosion, and earthquake hazards). To focus attention on Alaska's subsurface resource potential, DGGS makes the state's geologic information available on state-wide, national, and international levels.

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ROGRAM OBJECTIVES AND TASKS—FY01

STATE GEOLOGIST/DIRECTOR

The Director's Office provides leadership and coordination for the activities of the Division through the State Geologist/Director and Secretary.

OBJECTIVES

1. Provide executive leadership for the Geological Development Component and act as liaison between the Division and the DNR Commissioner's Office, other state agencies, and local, federal, and private entities.
2. Stimulate discovery and development of the geologic resources of the state through support of detailed geological and geophysical surveys.
3. Mitigate the adverse effects associated with natural geologic hazards.
4. Provide secure archival storage and access to the state's growing legacy of oil- and minerals-related geologic reference cores and samples, and other geologic data.

TASKS:

1. Prepare annual Division funding plan including Alaska General Fund base budget, Capital Improvements budget, and Federal initiatives.
2. Educate Alaska state legislators and Alaska federal delegation about the DGGS geologic program and its significance.



STATEWIDE MINERAL RESOURCE APPRAISAL

The decline of oil-generated revenues suggests that Alaska must move decisively to strengthen its subsurface resources economic base. To achieve this goal, Alaska needs private-sector commitment of capital and talent in non oil-related as well as oil-related industries. The mineral industry, however, will not commit major company resources or succeed on an acceptable timeline without dramatic advances in understanding the geologic environments of the most prospective Alaska lands open to mineral and other geologic resource development.

Alaska has an accessible state land endowment of more than 100 million acres, much of it chosen from a 350-million-acre land pool because of perceived potential to host mineral wealth. Currently the overwhelming majority of these lands are not geologically or geophysically surveyed at the detailed level or with the focus needed to optimize mineral discovery and development. Recently, a DNR/DGGS program of integrated geological and geophysical mapping has been effective in attracting new private-sector mineral investment capital to Alaska. The purpose of the FY01 Statewide Mineral

Resource Appraisal Project is to produce, on a prioritized schedule, the critical new geological surveys needed to sustain Alaska's mineral industry investments and provide management agencies with information needed to formulate rational management policy.

The Statewide Mineral Resource Appraisal Project also participates in the Division-wide task of implementing a comprehensive on-line computerized geologic reference database of Alaska for the public.



Implementation of the numerous elements of the Statewide Mineral Resource Appraisal Project is financed from a mixture of funding sources: General Fund base budget, Capital Improvement Projects funding, Federal Receipts, and Program Receipts.

OBJECTIVES

1. Catalyze increased mineral resource exploration in three mining districts within the next three years.
2. Provide DNR, other state agencies, and the public with unbiased, authoritative information on the mineral resources of the state so that rational land policy and investment decisions can be made.
3. Provide an accurate current statistical and descriptive summary of the status of Alaska's mineral industry for calendar year 2000.

TASKS

Project tasks and products financed by FY01 base budget General Funds, CIP Funds, Program Receipts, and Federal Receipts:

1. Supported in part by Federal Receipts, complete the second year of a three-year project



to acquire ground-truth geologic data of the Fortymile mining district airborne-geophysical survey tract and publish the data collected as an interim geologic map at a scale of 1:63,360. These ground-truth data will provide the geologic control needed to interpret the airborne-geophysical data acquired in FY99. This program also serves as the current focus for an ongoing Alaska-Yukon cooperative exchange of geologic and mineral inventory data.

2. Conduct a reconnaissance geologic ground-truth mineral inventory orientation survey of part of the Pogo geophysical tract and summarize findings in an interim status report. This mapping project is designed for completion in 3 years following FY01.
3. Supported by Federal Receipts, compile mineral deposit data files for three 1:250,000-scale quadrangles that encompass prospective mineral terranes.
4. Prepare and publish DGGs's annual report on mineral industry activity in Alaska, *Alaska's Mineral Industry 2000*.
5. Supported by Federal Receipts, construct DGGs geologic data and information Management System that provides access to mineral-related geologic, geophysical, and geochemical data via the Internet.
6. Acquire, prepare, and release private-sector geologic and geochemical data for the Delta mining area in central Alaska.
7. Provide authoritative briefings about the status of Alaska's mineral industry, state support for mineral ventures, and recently acquired geophysical and geological data at professional mineral industry conventions and trade shows, and in professional journals.

STATEWIDE ENERGY RESOURCE ASSESSMENT

The Statewide Energy Resource Assessment project produces new geologic information about the state's oil, gas, and coal resources. With the current reduction in oil-generated revenue to the state's economy because of declining oil field reserves, new areas of significant hydrocarbon discovery are needed to maintain or increase major revenue payments to the state. There is a need for acquisition of fundamental geologic data using modern concepts and techniques to enable industry to better fo-

cus its exploration in new prospective areas beyond the core Prudhoe Bay area. Recent DGGs work in the western North Slope is catalyzing new industry interest in the west-central Arctic. Therefore, by design, in FY01 this project continues to focus significant effort on frontier state lands in the central North Slope and within the southeastern corner of the National Petroleum Reserve—Alaska (NPRA).



The DGGs NPRA Foothills project involves two integrated components—geologic mapping and focused stratigraphic studies. Geologic mapping will be completed in the northwest corner of the Philip Smith Mountains Quadrangle and selected inch-to-the-mile quadrangles in the eastern half of the Chandler Lake Quadrangle. Continued detailed stratigraphic studies that examine reservoir potential within a high-resolution stratigraphic framework for the Torok and Nanushuk groups are being expanded upsection into younger strata. This integrated program is designed to provide the regional geology along with structural and stratigraphic details needed by industry in exploring for new oil and gas resources in the NPRA and on state lands to the south.

Importation of large volumes of diesel fuel into rural Alaska for heating and electrical power generation is expensive and has the potential for catastrophic spills affecting the local ecosystems on which rural residents rely for food. High energy costs hamper the development of remote mineral deposits as well. Because significant commercial oil and gas potential remains in the North Slope and Cook Inlet regions where production infrastructures are already in place, industry is reluctant to explore for energy resources where the commercial petroleum potential is uncertain. Coalbed methane and shallow, sub-commercial gas fields could serve the future energy needs in some of Alaska's rural communities, reducing costs and hazards to rural residents and the state alike. Local energy sources may also encourage mineral development, enhancing rural employment

opportunities through the creation of new mining jobs. Contingent upon funding, DGGs will collect subsurface geologic and hydrologic data through exploratory drilling to evaluate coalbed methane potential at one or more of three sites in rural Alaska.

The numerous elements of the Statewide Energy Resource Assessment Project are financed from a mixture of funding sources: General Fund, Program Receipts, Federal Receipts, and Capital Improvements Projects funding.

OBJECTIVES

1. Catalyze active private-sector exploration on the North Slope beyond the Prudhoe Bay fields.
2. Identify sources of energy in rural Alaska for the generation of heat and power in those areas.
3. Provide DNR, other state agencies, and the public with authoritative information relating to the energy resources of the state so that rational policy and investment decisions can be made.

TASKS

Project tasks and products financed by General Fund, Program Receipts, and Federal Receipts in FY01 are:

1. Contingent upon available funding from state or federal sources, complete seismic geophysical surveys of potential coalbed methane drill sites at one of three rural target communities (Chignik, Fort Yukon, or Wainwright).
2. Contingent upon securing funds to fulfill



Legislatively Designated Program Receipts authorization, determine the oil reservoir characteristics of Nanushuk Group sandstones exposed along 120 miles of the northern Brooks Range foothills to provide key geologic framework elements to catalyze future oil exploration in the central North Slope.

3. Update and convert to digital format the framework geology encompassed on five

conventional paper-based 1:250,000-scale geologic maps (about 30,000 square miles) of the western North Slope as an aid to future oil exploration in the central and western North Slope.

4. Acquire new geochemical data for coal in the Copper River Basin in order to classify that coal resource's quality in support of future coal prospecting and leasing, or coalbed methane gas exploration.

STATEWIDE ENGINEERING GEOLOGY/CONSTRUCTION MATERIALS

The Statewide Engineering Geology Project addresses major engineering-geology and geologic-hazard issues that affect public safety and economic well being in developing areas of Alaska. DGGs conducts engineering-geologic mapping to determine the distribution and character of surficial deposits, their suitability for foundations, susceptibility to erosion, earthquakes and landslides, and other geologic hazards. Geologic evaluations of areas subject to major hazards like floods, earthquakes, volcanic eruptions, and landslides help predict the likelihood of future major events, the severity of hazards associated with them, and suggest alternatives to avoid or reduce the effect of these hazards. In addition to General Funds, several elements of the Statewide Engineering Geology Project are partially or largely financed from Federal Receipts or Program Receipts.

A common view held by the general public is that insurance provides the best protection against losses from major disasters. However, in the wake of several recent costly disasters from earthquakes, hurricanes, floods, and landslides, insurers and the federal government are re-examining their past practices regarding disaster recovery.

Insurers are restricting coverage in whole regions, increasing premiums and deductibles, and trying to move toward a risk-based rather than a market-based pricing system. Internally, the federal government is voicing resistance to the self-insurance practices of state and local governments because after disastrous damage to infrastructure, these entities invariably turn to the federal government seeking monetary relief for recovery. There is growing resistance by the federal government to fund disaster recovery for damage that could have been avoided through prior mitigation. Every person and enterprise within Alaska's high-risk communities is going to be directly affected by these policy trends.

Alaska's communities at high risk from major geologic hazards include the majority of Alaska's citizens and a large majority of the state's corporate headquarters. In many urban areas, the state lacks the fundamental data needed to guide the proper implementation of building codes, land-use zoning, right-of-way siting, property insurance regulation, and contingency planning for adverse natural hazard events. Within these towns and cities, damage to existing infrastructure as well as individual buildings can be reduced. Informed land-use zoning, building-code application, and emergency planning can reduce damage costs and casualties from future events. However, economics dictates that mitigation measures be implemented first where risk is highest. Because hazards are not uniformly distributed even on a local scale, engineering-geologic and hazard maps become the first source of information about where damage is likely to be greatest and, therefore, where mitigation efforts need to be concentrated. These maps are critical for emergency planning and the allocation of emergency-response resources prior to an adverse event.

The DGGs Construction Materials Resources project provides information on the riprap, sand,



and gravel construction materials needed for private and public infrastructure construction. The information provided expedites the design and planning phases of state and private construction projects and helps control the cost of those projects for which this information is available. Sources of construction materials are of special concern in much of rural Alaska where coarse riprap is needed for erosion control near towns and villages, and gravel is needed for local and regional roads. During FY01, this project is focusing on mapping materials resources in the Fortymile mining district of east-central Alaska, to support the expansion of the state's mineral industry.

Implementation of FY01 Statewide Engineering Geology and Construction Materials projects outlined below is supported by General Fund, Federal Receipts, and Program Receipts moneys.

OBJECTIVES

1. Protect health and public safety by providing information on geologic hazards as they affect human activity.
2. Lower the costs of construction design and improve prior planning to mitigate consequences arising from natural geologic hazardous events and conditions.
3. Provide reliable engineering-geologic data for informed land-use decisions by the government and private sector.
4. Identify sources of sand, gravel, rip-rap, stone, and other geologic construction materials required to create the infrastructure, roads, and other land-based transportation corridor improvements necessary to support expanded development of natural resources and other local economic activities, such as tourism, in the state of Alaska.

TASKS

Project tasks and products financed by the General Fund, Federal Receipts, and Program Receipts monies in FY01 are:

1. Contingent upon securing funds to fulfill Federal Receipts authorization, complete maps of seismic soil response and earthquake-induced liquefaction susceptibility in the Anchorage area that will be used in conjunction with local building codes for earthquake-resistant planning, design, and construction.
2. Contingent upon securing funds to fulfill Fed-

eral Receipts authorization, and in cooperation with the Division of Emergency Services, University of Alaska Geophysical Institute, and coastal communities, publish tsunami-inundation maps for one of two selected coastal communities.

3. Partially supported by Federal Receipts secured in FY00, publish a compilation of all available information on active faults in Alaska, including maps on a CD-ROM showing fault traces digitized at 1:250,000 scale



or larger and a report that presents all information in a consistent format.

4. Produce written evaluations of potential hazards in areas of oil exploration leases, land disposals, permit applications, coastal management reviews, etc., and respond to verbal requests for information from other state agencies, local government, and the general public.
5. Conduct post-event hazard evaluations in response to unexpected major geologic events (for example, earthquakes, volcanic eruptions, and landslides), providing timely information dispersal to the public via electronic as well as traditional methods, and providing event and continuing hazard information to appropriate emergency management agencies.
6. Contingent upon securing funds to fulfill Federal Receipt authorization, publish geologic maps of Mt. Spurr and Shishaldin volcanoes for improved assessment of hazards from these active volcanoes.
7. Contingent upon securing funds to fulfill Federal Receipt authorization, maintain and

- enhance the Alaska Volcano Observatory web site.
8. Provide oversight, coordination, and helicopter contracting for multi-team fieldwork to conduct geologic-hazards studies and seismic network maintenance of active volcanoes in the Cook Inlet, Alaska Peninsula, and Aleutian Islands regions.
 9. Contingent upon securing funds to fulfill Federal Receipts authorization, participate in volcano eruption response and hazard mitigation as needed to provide timely and accurate warnings and eruption information to emergency-response agencies and air-traffic controllers.
 10. In support of the Statewide Mineral Resource Appraisal Program, complete the ground-truth surficial-geologic and engineering-geologic mapping of up to 500 square miles of high-potential mineral tracts to produce the geologic data needed to assess the placer-mineral resources, construction material resources, and potential geologic hazards that may affect development of Alaska's mineral industry in these areas.
 11. Compile a GIS-based directory of current construction-materials producers in Alaska, including location, commodity, and production data, and establish a mechanism to maintain and update these data annually.
 12. Update and expand the existing GIS-based bibliography of industrial mineral sites in Alaska, and publish the data digitally via the Internet and CD-ROM in order to document and inventory Alaska's potential economic commodities and make the information available to the public.

GEOLOGIC MAPS AND REPORTS

The Geologic Maps and Reports project edits, publishes, and disseminates technical and summary reports and maps generated by the Division's technical projects about Alaska's geologic resources. The maps and reports released through this project are the state's primary vehicle for widely disseminating factual information and data relating to its subsurface mineral and energy wealth, its geologic construction materials, and its engineering geology. These documents focus attention on Alaska's most geologically prospective and useful lands and are the authoritative basis for many of the state's resource-related land policy decisions. They also stimulate geologic exploration investment leading to resource discoveries and subsequent major capital investments. Timely availability of information derived from DGGS geological surveys is a significant factor in creating a more sustainable economy to offset the decline in Prudhoe Bay oil production.



This project began extensive use of the Internet in FY98 to enhance the disbursement of the Division's information and to provide state and worldwide access to the Division's geologic information base. The Geologic Maps and Reports project also implements the core geologic database and information management function of DGGS. The Geologic Maps and Reports Project is financed through the General Fund, Federal Receipts, and Program Receipts.

OBJECTIVES

1. Disseminate new, accurate, unbiased, Division-generated data on the geology of Alaska to the public at large, to interested DNR policy and regulatory groups, and to all other interested parties within one year of its acquisition.
2. Preserve and manage the data and knowledge generated by the Division's special and ongoing projects in an organized, readily retrievable, and reproducible form consistent with pertinent professional standards.
3. Focus public awareness on Alaska's most prospective mineral and energy lands.

TASKS

Project tasks and products funded by General Fund and Program Receipt moneys are:

1. Publish and distribute the DGGS annual report on Alaska's mineral industry.

2. Assemble and edit the technical and educational maps and reports of DGGS in both conventional and digital format.
3. Supported by Federal Receipts, deploy all of the existing DGGS geologic and geophysical maps and reports on the World Wide Web so that they are accessible to mineral and energy explorationists, engineering geologists, planners, engineers, and other interested parties via the Internet.
4. Coordinate the Division's many kinds of fundamental geologic data into a relational digital database to facilitate its more effective use by DGGS and private-sector geologists.
5. Publish a tri-annual newsletter of the Alaska Division of Geological & Geophysical Surveys to keep the public informed about DGGS projects and products.

GEOLOGIC MATERIALS CENTER

The Geologic Materials Center (GMC) archives and provides public access to non-proprietary oil, gas, and coal drill cores and drill-cutting samples, rock cores from mineral properties, and processed ore, oil, gas, coal, and source-rock samples. These samples are used by government and private-sector geoscientists to improve the odds of finding new oil, gas, and mineral deposits that will maintain the flow of state revenues and provide in-state employment. The Geologic Materials Center Project is financed from the General Fund budget and in-kind contributions directly from industry. The private sector contributes the cost of delivering all new samples, sample preparation and analyses, sample logs, and data logs.

The holdings of the GMC are a continually growing asset that is compounding in value over time at little cost to the state. The GMC facility is staffed by one Division geologist and numerous private-sector volunteers. The

GMC has formal cooperative agreements with the U.S. Geological Survey, the U.S. Minerals Management Service, and U.S. Bureau of Land Management to house and control their Alaska geologic materials. A voluntary 14-member board advises the GMC project leader and DGGS on matters pertaining to the GMC.

OBJECTIVES

1. Enhance oil revenues and in-state employment opportunities by making oil, gas, and mineral exploration more effective.
2. Advance the knowledge of the geology and resources in Alaska's low-lying structural basins favorable for oil or gas discovery.
3. Advance the knowledge of Alaska's mineral potential by making available representative samples of ores and drill cores from mineral deposits throughout the state.

TASKS

Project tasks and products financed by FY01 base-budget General Funds, CIP Funds, Program Receipts, and Federal Receipts:

1. Maintain the state's interagency archive of geologic materials (voucher samples of rocks, oil-and-gas well processed samples, core, rock thin-sections, ore samples, and hard-rock mineral deposit core) acquired from private companies and state and federal agencies.
2. Acquire and archive new geologic material pertinent to Alaska's energy and mineral resource development as they are donated to the GMC.
3. Establish and maintain the GMC sample database on the World Wide Web so that the catalog of the Center's holdings is accessible to mineral and energy explorationists and other interested parties via the Internet.



TECHNICAL SUPPORT

The Technical Support group provides financial control and administrative support for all other projects in the Geological Development component including: securing lowest costs for goods and services; maintaining, and when necessary, procuring vehicles for field work; coordinating travel arrangements and appropriate paperwork to minimize travel expenses and field party subsistence costs; negotiating the helicopter contract; administering and monitoring grants and contracts; tracking and reporting project expenditures to ensure cost containment within budget for all projects; mail/courier services; assistance in personnel matters; petty cash; and any other support necessary to further increased efficiency or savings in acquiring knowledge of the geology of Alaska.

OBJECTIVE

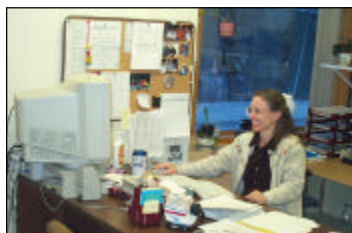
1. Facilitate the efficient execution of DGGG programs and projects.

TASKS

1. Monitor grants and contracts (Federal, Interagency, and Program Receipts) to ensure deliverables are produced on schedule and within budget; ensure expenses are properly billed against grants and contracts and receipts are collected promptly.
2. Provide accurate, timely reporting of project expenditures and current balances; encourage prudent money management.
3. Decrease the cost of transportation to the field by coordinating personnel travel and supply shipments; negotiate long-term helicopter contracts in cases where helicopters

are necessary; coordinate Division vehicle use and decrease requests for reimbursement for personal vehicle mileage.

4. Make travel arrangements and complete travel authorizations to ensure use of the lowest cost travel options.
5. Provide communication between remote field camps and office, allowing for unforeseen circumstances, expediting field supplies, and personnel safety.
6. Assist staff with personnel matters; keep staff informed about changes in personnel rules or benefits and ensure that all personnel paperwork complies with applicable rules and regulations. Estimate future personnel salaries and benefits to assist management in making human resource decisions necessary to efficiently produce the greatest amount of resource information.



FEDERAL RECEIPTS

Federal Receipts authorizations allocate grant or contract funds received from federal agencies for cooperative or matching fund projects such as investigations of mineral and materials resources, energy resource investigations, and geologic hazard assessments. All these projects increase information on Alaska's geologic resource base or the geologic engineering parameters of natural conditions affecting development activities and public safety. Most projects are unique single- or multi-year projects that are implemented as funds are available from cooperating federal agencies.

OBJECTIVES

1. Maximize the return on Alaska General Fund moneys expended to meet the mandate of AS 41.08.020 through federal grant and cooperative project funding support of Alaska's geologic survey priorities.
2. Conduct geological and geophysical surveys to determine the potential of Alaskan land for the production of metals, minerals, and fuels.
3. Determine the potential geologic hazards to buildings, roads, bridges, and commerce

- from earthquakes and volcanic eruptions.
4. Conduct other surveys and investigations that will advance the knowledge of the geology of Alaska.

TASKS

Tasks that will be financed in part by Federal Receipts in FY01 are:

1. Completion of an airborne-geophysical survey of about one-third of a 3,500-square-mile high-mineral-potential area in part of the Iditarod-Aniak mining districts of southwestern Alaska.
2. Complete the second year of a three-year project to acquire ground-truth geologic data of the Fortymile mining district airborne-geophysical survey tract and publish the data collected as an interim geologic map at a scale of 1:63,360.
3. Compile mineral deposit data files for three 1:250,000-scale quadrangles that encompass prospective mineral terranes.
4. Construct a geologic data and information database system providing access to DGGS mineral-related geologic, geophysical, and geochemical data.
5. Contingent upon securing funds to fulfill Federal Receipts authorization, complete maps of seismic soil response and earthquake-induced liquefaction susceptibility in the Anchorage area that will be used in conjunction with local building codes for earthquake-resistant planning, design, and construction.
6. Contingent upon securing funds to fulfill Federal Receipts authorization, and in cooperation with the Division of Emergency Services, University of Alaska Geophysical Institute, and coastal communities, publish tsunami-inundation maps for the Kodiak area.
7. Partially supported by Federal Receipts, publish a compilation of all available information on active faults in Alaska, including maps on a CD-ROM showing fault traces digitized at 1:250,000 scale or larger and a report that presents all information in a consistent format.
8. Contingent upon securing funds to fulfill Federal Receipt authorization, publish geologic maps of Mt. Spurr and Shishaldin volcanoes for improved assessment of hazards from these active volcanoes.
9. Contingent upon securing funds to fulfill Federal Receipt authorization, maintain and enhance the Alaska Volcano Observatory web site.
10. Supported by Federal Receipts, post all of the existing DGGS geologic and geophysical maps and reports on the World Wide Web so that they are accessible to mineral and energy explorationists, engineering geologists, civil engineers, and other interested parties via the Internet.
11. Complete pre-drilling site assessments of three rural Alaska communities to evaluate the potential for producible coalbed methane to meet village energy needs.
12. Conduct field examinations of coal outcrops within and along the perimeter of the Copper River Basin to collect new coal quality and quantity data for inclusion into the Alaska coal database of the U.S. Geological Survey's National Coal Resource Data Sys-

PROGRAM RECEIPTS

This project allocates funds received from governments, private industry, academic institutions, and the general public from sale of publications. The sale of these publications increases information on Alaska's geologic resource base, or the geologic engineering parameters of natural conditions affecting development activities.

OBJECTIVES

1. Maximize results from Alaska General Fund and CIP moneys through Program Receipts to meet the mandate of Alaska Statute AS 41.08.020.

2. Provide for the timely release of mineral, energy, and geologic construction materials-related geologic data that will focus attention on the most promising Alaska lands having the potential to sustain or diversify Alaska's economy, or on those lands having a critical impact on Alaska citizens.

TASKS

1. Reproduce out of print DGGS publications, Public-Data Files, and selected maps and reports on an as-needed basis for the public, state, and federal agencies.

DESIGNATED PROGRAM RECEIPTS

This project allocates funds received from local governments, private industry, and the general public. All of these projects increase information on Alaska's geologic resource base, or the geologic engineering parameters of natural conditions affecting development activities. Most elements are one-time single- or multi-year tasks that are undertaken as funds are available from cooperating agencies. We do not normally know in advance which projects, if any, will be funded during the forthcoming budget year.

OBJECTIVES

1. Maximize results from Alaska General Fund and CIP moneys through Program Receipts to meet the mandate of Alaska Statute AS 41.08.020.
2. Provide for the timely release of mineral, energy, and geologic construction materials-related geologic data that will focus attention on the most promising Alaska lands having the potential to sustain or diversify Alaska's economy, or on those lands having a critical impact on Alaska citizens.

TASKS

In FY01, the Division plans to generate \$125,000 in Designated Program Receipts from private industry to be used for the projects described below. Without Designated Program Receipts funding, these projects will not be accomplished due to lack of funding and resources within the Division.

1. The NPRA–Chandler Lake project is the second year of the five-year NPRA–Brooks Range Foothills program designed to understand the detailed stratigraphy of Cretaceous-age sedimentary rocks in the Brooks Range foldbelt and their reservoir and source-rock potential in frontier areas. The objective of this work is to generate industry exploration interest in frontier regions of the North Slope. The preliminary results from the first year of this program resulted in significant industry interest for DGGs's FY01 studies and increased exploration activity in eastern NPRA and adjoining state lands to the south.

FY20001 FINANCIAL RESOURCES SPENDING PLAN

	General Fund	Federal Receipts	Legislatively Designated Prgm. Rcpts.	Statutory Designated Prgm. Rcpts.	Inter-Agency Receipts	Direct Charge CIP	Capital Improvement Projects	Total by Project*
Director/ State Geologist								0.0
Mineral Resource Appraisal	371.2	476.0				0.0	100.0	947.2
Energy Resource Assessment	527.8	255.1		126.0		0.0	763.3	1,672.2
Engineering Geology	272.7	575.6			87.2			935.5
Geologic Maps and Reports	531.8	365.0	29.9					926.7
Geologic Materials Center	112.0	5.0						117.0
Technical Support	172.5							172.5
Annual Minerals Report	49.8							49.8
Total by Fund Source	2,037.8	1,676.7	29.9	126.0	87.2	0.0	863.3	4,820.9

*Dollar amounts in thousands.

P PROJECT SUMMARIES—FY01

Alaska is a young and dynamic state. We face the challenge of developing a viable economy from our natural resources while protecting an environmental legacy that is the envy of many. The Department of Natural Resources' Division of Geological & Geophysical Surveys is an integral partner in the team of state agencies that strive to meet this challenge. The output from our projects provides the fundamental science required to guide critical policy decisions, catalyze investment, mitigate the effects of geologic hazards, and improve the quality of life for all Alaskans.

The following overviews of the 27 projects that are being pursued by DGGS in FY01 span the scope of our legislative mission statement. Each of these projects is making a positive difference for Alaska. Each is implemented through various cooperative agreements with other state and federal agencies, in-house project teams, and contract. We seek to leverage state General Funds through these arrangements so that we can maximize the annual coverage of our work.



ANNUAL ALASKA MINERAL INDUSTRY REPORT

Contact: David J. Szumigala, Mineral Resources Section, (907) 451-5025, zoom@dnr.state.ak.us

DGGS produces an annual summary report on the Alaska mineral industry. The report has been published for 19 consecutive years as a cooperative venture between DGGS in the Department of Natural Resources (DNR) and the Division of Community & Business Development (DCBD) in the Department of Community & Economic Development (DCED), with help from the Division of Mining, Land & Water (DMLW) in DNR. The summary of the 1999 Alaska mineral industry is made possible by information provided through replies to questionnaires mailed by DGGS, phone interviews, press releases, and other information sources.

Publication of the annual mineral industry report by DGGS is motivated by Alaska Statute 41.08 that charges the division *"to determine the potential of Alaska land for production of metals, minerals, fuels, and geothermal resources; the location and supplies of groundwater and construction materials; the potential geologic hazards to buildings, roads, bridges, and other installations*

and structures; and shall conduct such other surveys and investigations as will advance knowledge of the geology of Alaska." Our objective is to supply information on Alaska's mineral industry in a timely manner that will assist the mining industry and foster a better understanding of the significance of the mineral industry to Alaska's private sector and government.

The annual Alaska mineral industry report is a key source of information about Alaska's mineral resource development. Statewide and international circulation of the annual mineral industry report informs the general public, local and international mineral industry, and local, state, federal and international government agencies about current activities within the Alaska mineral industry. The report serves as a barometer for the mineral industry's status within any given year and provides unbiased authoritative information. Government personnel formulating public policy affecting resource and land management rely on the report as an essential asset.



GEOLOGIC GROUND-TRUTH INVENTORY OF FORTYMILE MINING DISTRICT GEOPHYSICAL SURVEY TRACT

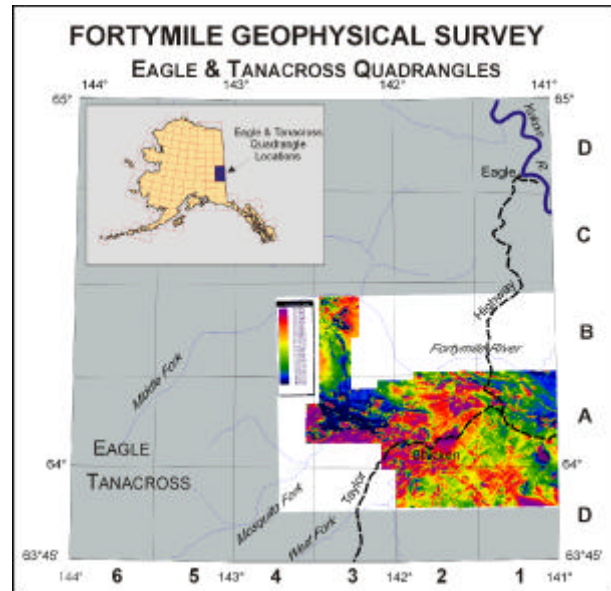
Contact: David J. Szumigala, Mineral Resources Section, (907) 451-5025, zoom@dnr.state.ak.us

DGGS is completing year two of a three-year program to provide geologic ground truth for airborne geophysical surveys flown in the Fortymile mining district in 1998. The Fortymile project is part of DGGS's airborne geophysical/ geological mineral inventory project, a special multi-year investment by the state of Alaska to expand the knowledge base of Alaska's mineral resources and catalyze private-sector mineral development. Major funding for year 2000 fieldwork is derived from the federal STATEMAP program. The Fortymile mining district is the oldest placer gold camp in Alaska. This area, located in eastern Alaska near the Alaska-Yukon border, is drained by the Fortymile River system. The Taylor Highway provides road access through the eastern and central portions of the district and the DGGS map area. Alluvial gold was first discovered on Franklin Gulch in the Fortymile River area in 1886. More than 535,000 ounces of gold have been produced from the district, but less than 300 ounces of this production were from lode mining.

DGGS efforts are focused on determining and understanding the geologic environments of the Fortymile mining district, especially with respect to placer gold and lode mineralization. No large-scale source(s) for the district's abundant placer gold resource have been located, although several lode gold prospects (Purdy and Napoleon) are present in the map area. Other potential mineral deposit types include plutonic-hosted gold deposits, skarns, copper-molybdenum porphyry deposits, ultramafic-hosted platinum deposits and volcanogenic massive sulfide deposits.

Recent DGGS geologic mapping determined that high-grade and low-grade metamorphic rock assemblages in the Eagle A-2 Quadrangle contain units that define a mappable stratigraphy in this portion of the Yukon-Tanana terrane. Results of recent mapping by DGGS do not support some of the current terrane assignments in the Fortymile area. Extensive high-angle faulting (with relatively young uplift) suggested by geophysical data was corroborated in the field and is part of a complex structural history.

Preliminary $^{40}\text{Ar}/^{39}\text{Ar}$ data from igneous rocks, along with previously published dates indicate that pluton ages in the Eagle A-2 and A-1 quadrangles are Triassic, Jurassic, or Cretaceous. Compositional variations in plutonic rocks correlate well with different ages of plutonism. All felsic-intermediate plutonic rocks in-



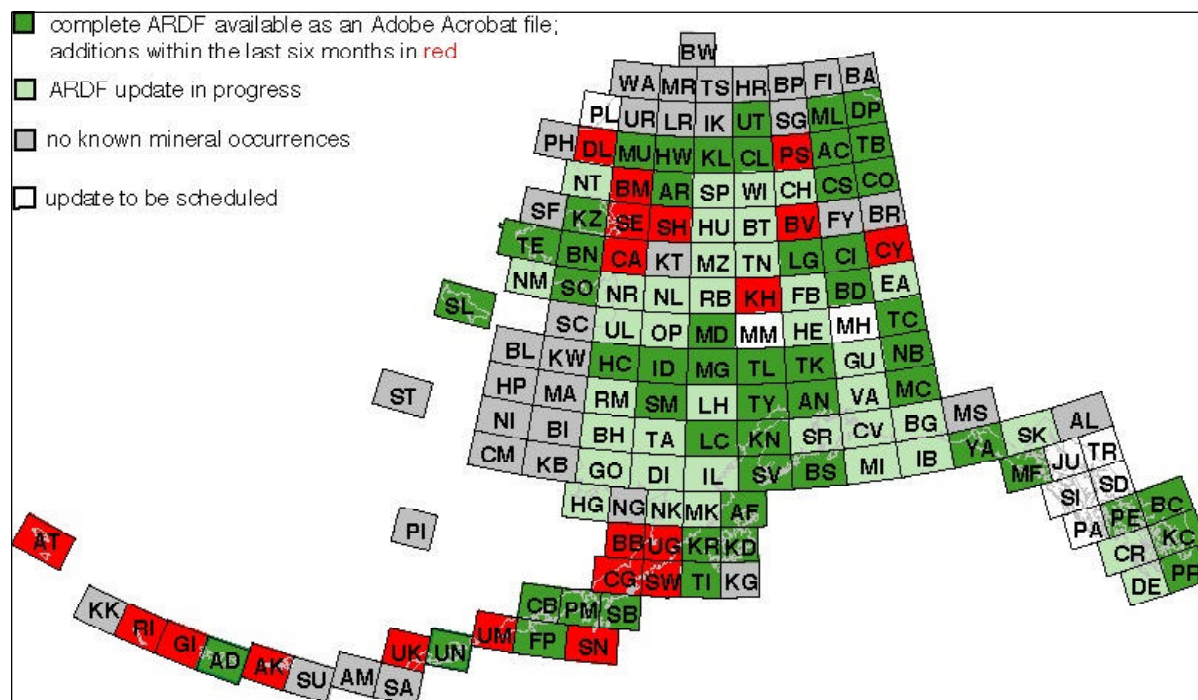
vestigated to date have trace element characteristics similar to those of volcanic-arc granitoids, suggesting at least two periods of subduction-related magmatism. In contrast, trace-element compositions of Tertiary(?) felsic volcanic rocks resemble those of within-plate volcanic rocks, consistent with the bimodal character of early Tertiary magmatism in the region.

In addition to bedrock-geologic mapping and sampling, DGGS is conducting surficial studies in the Fortymile study area to address the potential for additional placer gold resources, location and character of construction materials for future development, and potential geologic hazards that may impact all future users.

A series of geologic-framework and geophysical maps at approximately 1:63,360 scale, and reports containing geological, geochemical, and geophysical data compilations will be produced by this project. Project maps and reports will be available on the Worldwide Web at the DGGS website. DGGS's integrated geophysical/geological program in the Fortymile area will provide a modern geologic framework for this region, provide the State with updated inventories of geologic resources to guide planning activities, and identify additional areas of potential interest.

ALASKA RESOURCE DATA FILE PROJECT (ALASKA MINERAL DEPOSIT DATABASE)

Contact: Melanie B. Werdon, Mineral Resources Section, (907) 451-5082, melanie@dnr.state.ak.us



DGGS has a cooperative agreement with the USGS as part of the federal *Minerals Data and Information Rescue in Alaska* program. The primary objective of the Data and Information Rescue project is to ensure that all Alaska mineral data are preserved in a safe and readily accessible format for all potential users. Information on mineral resources is important for management policy decisions in both the public and private sectors. Higher quality data should lead to better economic, legislative, and environmental decisions. One component of this program is a digital (electronic) database of mineral deposits of Alaska known as the *Alaska Resource Data Files (ARDF)*. These files are the first comprehensive update of Alaska's mineral deposit database in a quarter-century.

Descriptions of mines, prospects, and mineral occurrences in the Alaska Resource Data File (ARDF) are compiled for individual USGS 1:250,000-scale quadrangles in Alaska (see accompanying map) as USGS Open-File Reports and are available for downloading from the USGS web page (<http://www-mrs-ak.wr.usgs.gov/ardf>). The records in the database are generally for metallic mineral commodities only but occasionally may include certain high value industrial minerals such as barite and rare-earth elements. Common industrial minerals such as sand and gravel, crushed

stone, and limestone, and energy minerals such as peat, coal, oil, and gas are not included in this database.

Descriptions in the ARDF database are derived from published literature, state mining claim files, state land status information, personal interviews, and unpublished reports and data from various sources including DGGS, the U.S. Bureau of Mines, the U.S. Geological Survey, Alaska Native corporations, and the mineral industry. Compilation of this database is an ongoing process and each report is a progress report. Planning is underway to keep this valuable database current as new mineral deposit discoveries and more detailed geologic and geochemical information become available in the years ahead.

DGGS will complete 9 to 15 quadrangle mineral deposit record-sets that meet peer review and USGS ARDF staff review criteria. Geologists and interns in the DGGS minerals section have completed ARDF files for the Big Delta, Tanacross, Kantishna River, and Charley River quadrangles. We have ARDF files for the Ruby Quadrangle in review, and are currently working on the Eagle, Melozitna, and Tanana quadrangles. We are also currently planning additional cooperative work with the USGS through the *Minerals Data and Information Rescue in Alaska* program.

GEOLOGIC GROUND-TRUTH INVENTORY OF THE IRON CREEK GEOPHYSICAL SURVEY AREA

Contact: Melanie B. Werdon, Mineral Resources Section, (907) 451-5082, melanie@dnr.state.ak.us

In 1999 DGGS participated in a 15-day geologic field mapping project in the Iron Creek airborne geophysical tract. This mapping project was done in cooperation with geologists from the mineral research program of the USGS in order to share personnel and field expenses. The objective of this project is to produce a joint publication of interpreted geological and geophysical data, and to evaluate the mineral resource potential of the area.

In fall 1999 DGGS and USGS released analytical data and sample locations from the Iron Creek area. In June 2000 DGGS released a geologic map in cooperation with USGS that covers approximately 100 square miles of the southeastern quarter of the Talkeetna Mountains B-5 Quadrangle. The map area is centered around known copper prospects in the Iron Creek area. Igneous and mineralized rock samples were collected for $^{40}\text{Ar}/^{39}\text{Ar}$ age determinations and are still being analyzed. A final map will be produced in FY01 after these age determinations are concluded.

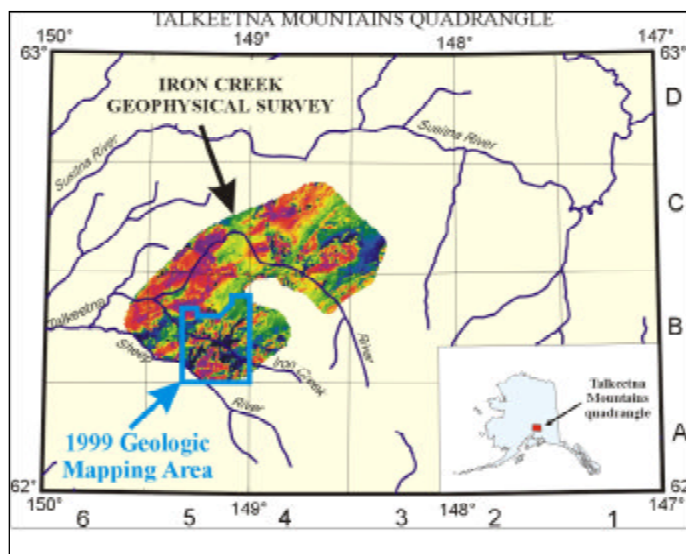
The new geologic map was produced at a scale of 1:63,360. Previously the Iron Creek area was mapped at 1:250,000 scale as predominantly Paleozoic volcanic rocks with minor limestone lenses intruded by two plutons. Our new mapping identified numerous other, previously unrecognized plutonic and volcanic rocks, of many different compositions, with probable ages ranging from Jurassic(?) to Tertiary. Probable Tertiary-aged, quartz-rich granitic plutons, rhyodacite dikes, volcanic breccias, and basalt dikes were found in the northern half of the map area. Other significant plutonic rock bodies mapped include tonalite/trondhjemite, hornblende-biotite granodiorite, monzonite, diorite/ gabbro, and hornblendite.

A large portion of the central map area contains amygdaloidal basalt, amygdaloidal gabbro, epidotized volcanic breccias, and fine-grained mafic rocks. These mafic units have many features characteristic of the Nikolai greenstone including (1) variable, but generally high magnetic susceptibility, (2) high TiO_2 content, (3) amygdules, (4) association with limestone, and (5) scattered quartz + hematite + epidote +/- chalcopyrite +/- bornite +/- pyrite veins and alteration. This suggests that these rocks can be assigned to the Wrangellia terrane. We also identified a separate unit consisting of mixed metasedimentary and

metavolcanic rocks that have been intruded by mafic sills with a low magnetic susceptibility, which tentatively may be correlative with Paleozoic rocks to the east. In the southeastern corner of the map area, another package of metavolcanic rocks may be part of the Peninsular terrane.

The map pattern of the mixed metasedimentary–metavolcanic–mafic sill package indicates large-scale folding of these units in the map area. Several isoclinal folds were observed. A sub-parallel set of younger, north-east-trending, high-angle faults was identified, one of which has a component of strike-slip motion based on horizontal slicken-slides along the fault surface. Based on map patterns of geologic units and geophysical data there also appears to be a major northwest-trending, high-angle fault with north-side-down displacement along the main fork of Iron Creek.

The recognition of numerous new plutonic rocks of varying compositions increases the potential of the Iron Creek area for epithermal and pluton-hosted mineralization. Numerous fracture- and shear-controlled copper–iron prospects and small skarn bodies were located and sampled. The presence of a metavolcanic–meta-sedimentary rock package with quartz–sericite–pyrite alteration in felsic metavolcanic rocks, and reported elevated Barium levels, suggest the potential for volcanogenic massive sulfide mineralization.



GEOLOGIC GROUND-TRUTH INVENTORY OF THE SALCHA RIVER–POGO GEOPHYSICAL SURVEY TRACT

Contact: Melanie B. Werdon, Mineral Resources Section, (907) 451-5082, melanie@dnr.state.ak.us

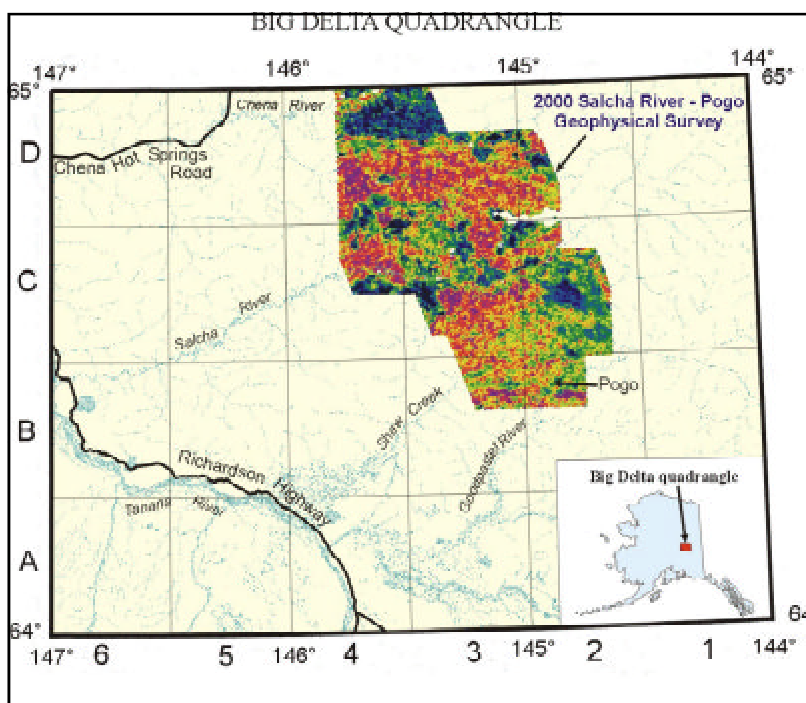
During the summer of 2000 DGGS conducted 15 days of geologic reconnaissance field mapping within the boundaries of the Salcha River–Pogo airborne geophysical survey. The geophysical survey covers 1,032 square miles in the Big Delta Quadrangle, and includes portions of the Salcha River and Goodpaster River drainage basins. The objective of this project is to produce a 1:63,360-scale bedrock geologic map of the geophysical tract, and to evaluate the mineral resource potential of the area. Currently the southern portion of the mapping area is of intense interest to the mineral exploration industry since it includes the Pogo property (a high-grade, plutonic-related, 5.1-million-ounce gold deposit), along with many other promising gold targets.

The northern quarter of the region is being actively explored for metasediment-hosted base-metal occurrences.

The Salcha River–Pogo project marks the first time DGGS has obtained airborne radiometric data in addition to aeromagnetic and resistivity data. Radiometric data may be a valuable tool since it delineates different geologic units and features than those highlighted by the aeromagnetic and resistivity data. These three complementary types of airborne data will be used to help with geologic mapping.

Initial work by DGGS in the Salcha River–Pogo area includes:

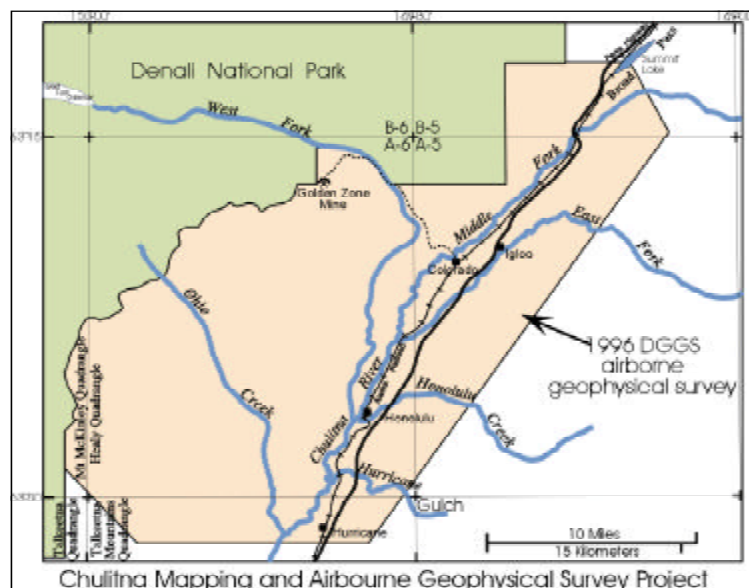
1. Collecting and analyzing igneous and meta-igneous rocks to categorize the many types of plutonic, volcanic, and orthogneiss suites in the Big Delta Quadrangle. Classifications will be based on rock textures, mineralogy, petrographic observations, major and minor oxide and trace element compositions, ages, geophysical signatures, and tectonic origin.
2. Delineating high- and low-angle faults, their sense of motion, cross-cutting relationships, and timing. For example, we will test different models



for movement on the prominent northeast-striking Shaw Creek fault by examining plutonic and metamorphic rocks on opposite sides of the fault.

3. Bedrock-geologic mapping in the Caribou Creek–south Salcha River region, an area with historical placer gold production, as well as recently discovered lode gold mineralization.
4. Examining the geology in the immediate area of the Pogo gold project, and comparing it to the geology seen in an area 10 kilometers to the west with a similar geophysical signature.
5. Digitally compiling existing published geologic data for the Big Delta Quadrangle, and actively seeking geologic data and input from the numerous mineral exploration companies working in the area.

A summary of our summer 2000 field and analytical work will be published by May 2001. DGGS plans to conduct additional fieldwork within the Salcha River–Pogo geophysical survey boundary in the summers of 2001, 2002, and 2003.



GEOLOGY OF THE DELTA MINERAL BELT

Contact: Laurel Burns, Mineral Resources Section, (907) 451-5021, laurel@dnr.state.ak.us

DGGS began a cooperative project with Northern Associates, Inc. (NAI) to prepare and release to the public a bedrock geologic map of the Delta mineral belt. This area is in the eastern Alaska Range in the Tok mining district about 85 kilometers west of Tok. The Delta mineral belt has been the subject of intense geologic investigation since volcanogenic massive sulfide occurrences were found there in 1976. The purpose of this project is to release knowledge into the public domain that was previously available to only a few private companies. Grayd Resource Corporation (Grayd) is the present owner of the geologic data and geologic materials upon which this project is dependent and has donated their data for this project.

According to Grayd Resource Corporation, from 1976 through 1990, about nine companies spent a total of approximately \$10 million on exploration in the Delta district. The money provided geophysical surveys, geochemical data, drill core, and geologic mapping at scales between 1:1,200 and 1:30,000. Many types of geophysical data including CEM, PEM, magnetics, Max-Min EM (HLEM), IP, Airborne EM 225 line-km gravity, down-hole PEM and seismic data, were acquired. The amount of core totaled 16,746 meters for the 134 drill

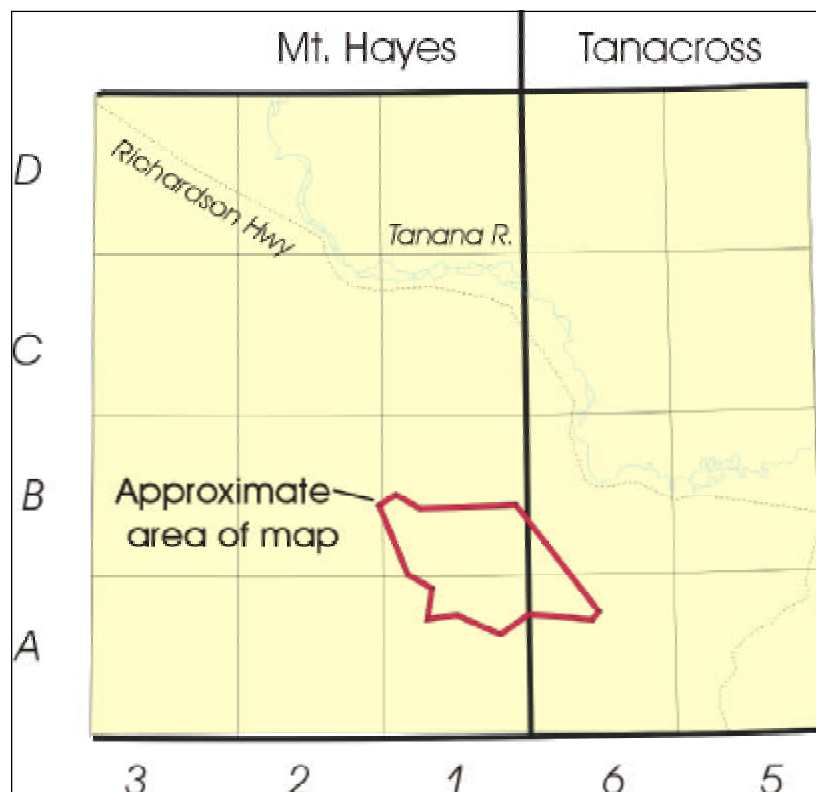
holes. Approximately 24,000 rock, drill core, stream sediment and pan concentrate samples were analyzed.

In 1993 American Copper & Nickel Company (ACNC) and Pacific Northwest Resources Corporation renewed exploration efforts in the area as a joint venture. They were given access to previous mapping, drill core, and other existing data. Between 1993 and 1998, these companies spent about \$8 million more in the area. During those six years, these companies conducted both reconnaissance and detailed geologic mapping of the area, analyzed an additional 2,600 rock samples and 1,890 core samples, conducted airborne and ground geophysics, and drilled 44 holes totaling about 10,800 m.

More than 40 mineral occurrences have been discovered within the Delta mineral belt. An inferred resource has been calculated for eight deposits. Study of the core and geologic mapping has resulted in a proposed detailed stratigraphic sequence for the area. The stratigraphy suggests that massive sulfide mineralization occurs in at least four stratigraphic levels.

The main products of this project will be more than 800 major oxide and XRF trace element analyses combined

with protolith determinations, new geochronologic data, and a new geologic map of the Delta mineral belt. The map will draw on the geologic mapping, lithochemistry, airborne geophysics, and core drilling that was carried out under the supervision of NAI personnel between 1994 and 1999 for ACNC and Grayd, and will utilize in-hand proprietary data that was developed by prior operators in the district.



SOUTHWESTERN ALASKA MINERAL DEVELOPMENT PROJECT

Contact Laurel E. Burns, Mineral Resources Section, (907) 451-5021, laurel@dnr.state.ak.us

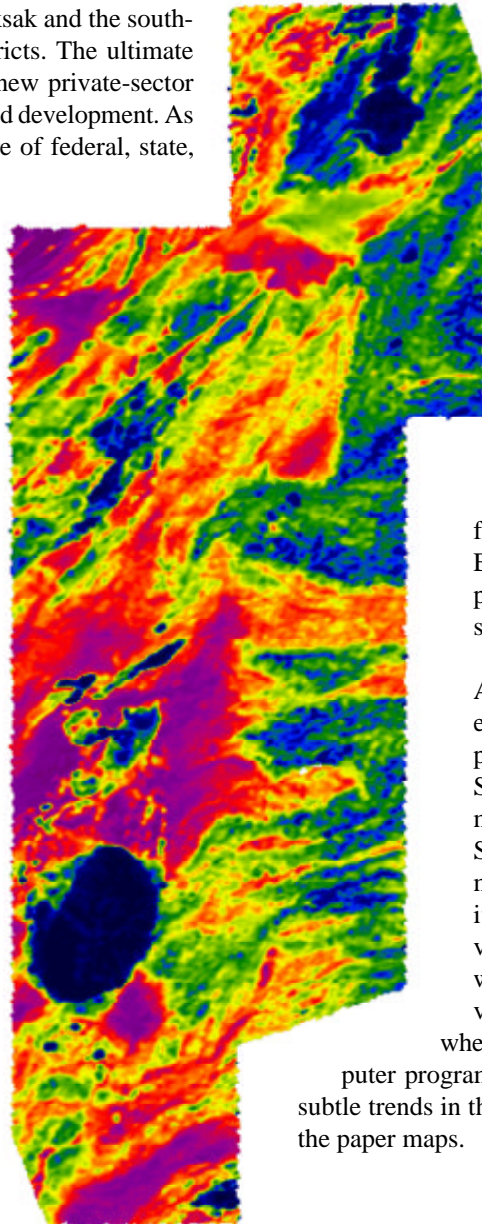
Aeromagnetic and airborne electromagnetic geophysical maps of the Aniak area in southwestern Alaska were released to the public September 7, 2000. The survey area covers about 1,240 square miles in parts of the Iditarod and Sleetmute quadrangles, and is in the northcentral part of the Aniak-Tuluksak and the southern part of the Iditarod mining districts. The ultimate goal of this program is to catalyze new private-sector investments in mineral exploration and development. As this land is roughly an equal mixture of federal, state, and Native lands, the program was a cooperative project funded by U.S. Bureau of Land Management (BLM) and contracted, monitored, and released to the public by DGGS. Both the private-sector and Native corporations are very interested in the area.

Most of the survey area is composed of the Cretaceous Kuskokwim Group, which consists of marine turbidites with lesser shallow-marine and fluvial rocks. Quaternary deposits mantle much of the area. A few sections of older metamorphic rock (Idono sequence) are exposed in the northern part of the survey area. A few volcano-plutonic complexes of Cretaceous-Tertiary age are exposed in the survey area and consist of andesite, basalt, plutonic rocks (ranging from alkali-gabbro to monzonite to granite), and rhyolitic and basaltic dikes. Major faults in the area include the northeast-trending Iditarod-Nixon Fork fault. Besides smaller northeast-trending faults, other faults trend northwest, north-south, and east-west.

Many factors led to this area being chosen for an airborne geophysical survey. The survey area is in the western part of a 3,600-square-mile area that has a high probability of gold, mercury, and polymetallic vein deposits. Several deposits and numerous prospects are known within the survey area, but are difficult to trace or find similar occurrences because of poor exposure. Donlin Creek, a major gold deposit near the center of the survey area, is

a structurally controlled quartz-sulfide veinlet deposit associated spatially and temporally with 70 Ma felsic dikes. The 1998 core-drilling program by Placer Dome indicated that Donlin Creek has 11.5 million ounces of contained gold. Over 2 million ounces of placer gold has been produced in the Aniak-Tuluksak and Iditarod mining districts. All this gold, though, did not come from the Donlin Creek deposit; the lode sources for these placer deposits have definitely not all been found. The volcano-plutonic complexes are considered favorable for poly-metallic vein deposits; these deposits may contain base-metal sulfides, sulfosalts, or gold. Epithermal mercury-rich vein prospects are also present in the survey area.

Acquisition of aeromagnetic and electromagnetic data was accomplished with a helicopter by Stevens Exploration Management Corp. and Fugro Airborne Surveys in spring 2000. Twenty magnetic and apparent resistivity maps were produced in a variety of formats. Digital data were also made available at a very low price to the public and, when viewed with appropriate computer programs, allow the user to see many subtle trends in the data that are not apparent on the paper maps.



NPRA-BROOKS RANGE FOOTHILLS PROGRAM

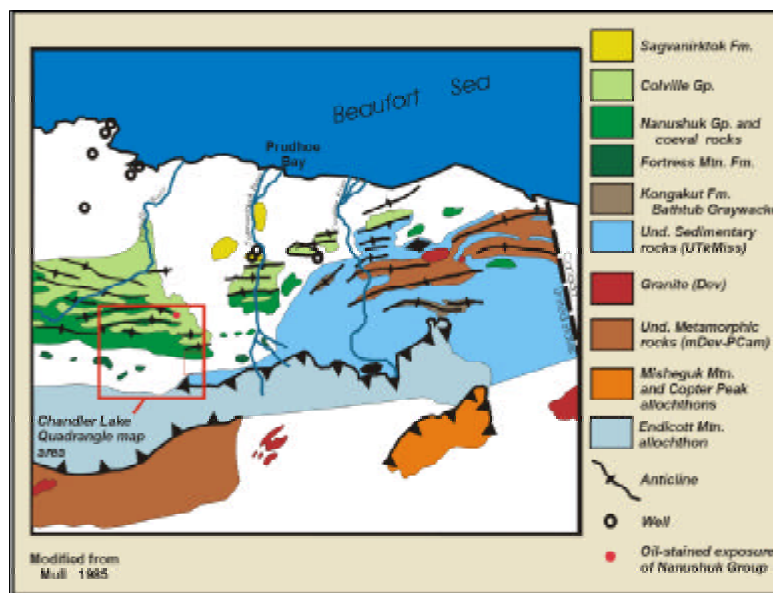
Contact: David L. LePain, Energy Resource Section, (907) 451-5011, davele@dnr.state.ak.us

The goal of this five-year program is to develop a detailed sequence stratigraphic framework for Cretaceous sedimentary rocks exposed in the foothills belt north of the Brooks Range, between the Dalton Highway in the east and the DeLong Mountains in the western Arctic.

The reservoir quality of selected sandstone bodies and source rock potential of shales in the Cretaceous succession will then be evaluated within this detailed stratigraphic context. The geographic focus of the FY01 field season was the Chandler Lake Quadrangle, shown in the inset map below. DGGS will complete work in the Chandler Lake and Philip Smith Mountains quadrangles during FY02. During subsequent seasons the study area will gradually shift westward, and will reach the DeLong Mountains by FY04.

During the FY01 field season, three detailed stratigraphic sections were measured through portions of the Nanushuk Group at Ninuluk Bluff west of Umiat, at Big Bend of the Chandler River, and on the north side of Tuktu Bluff. In addition, stratigraphic sections at Arc Mountain and Rooftop Ridge, begun during the FY00 field season, were completed. Of particular economic significance, several sandstone beds in the Nanushuk Group throughout the Rooftop Ridge section and near the top of the Big Bend section have strong hydrocarbon odors, and one bed near the base of Rooftop Ridge section is visibly oil-stained. Oil-stained sandstones were observed in the Torok Formation approximately 30 miles west of this location during the FY98 season, which suggests hydrocarbon migration through and/or storage in sandstones of the Torok and Nanushuk Group over a large geographic area, including Alaska State lands. The Arc Mountain and Rooftop Ridge sections represent an important north-south (non-marine to marine) transect through Torok and Nanushuk depositional systems that helps constrain paleogeographic reconstructions of the Lower Cretaceous shoreline. A significant intra-formational unconformity was identified in the Ninuluk Bluff section, which suggests significant coeval deep-water sandstones with hydrocarbon reservoir potential might be present in the subsurface to the northeast.

In addition, facies studies of sandstones and conglomerates of the Upper Cretaceous Tuluvak Formation were begun. This formation in outcrop contains rocks with excellent porosity and permeability that suggest that the horizon might be an excellent hydrocarbon objective in



the subsurface. An extensive program of sampling for organic geochemical analyses to study the hydrocarbon source rock potential of rocks in the Brooks Range foothills fold belt was also conducted. The field data suggest the presence of more oil-prone source rocks than indicated by previous mapping in the area.

In conjunction with stratigraphic studies during the FY01 field season, field checking of a digitized copy of an older 1:125,000-scale geological map of the Chandler Lake Quadrangle was completed. This map is one of a series of maps being digitized by the U.S. Geological Survey in a collaborative program with this project, and will be released in FY01.

Products from this project will include: 1:63,360-scale geologic maps of the Chandler Lake B-2 Quadrangle (released spring FY00), Chandler Lake C-2, D-2, and part of D-1 quadrangles (released spring FY01); measured sections (released during the winter following each field season); summary of the petrology and reservoir quality of selected sandstone bodies (released winter FY03); and a report summarizing the sequence stratigraphy and reservoir quality of Cretaceous rocks (released winter FY05).

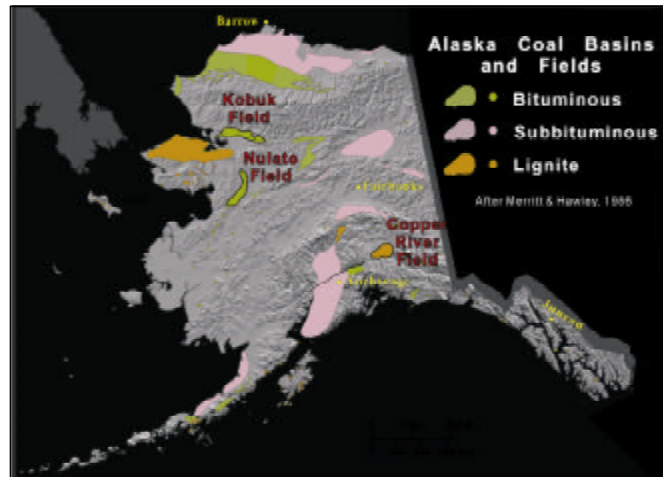
ALASKA COAL DATABASE NATIONAL COAL RESOURCE DATA SYSTEM

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The long-term goal of the Alaska Division of Geological & Geophysical Surveys' (DGGS) participation in the U.S. Geological Survey's (USGS) cooperative National Coal Resource Data System (NCRDS) program is to record all known coal resources in Alaska, and archive the data in a single readily-accessible database. Encoded and formatted data for northwest, northern, interior, southcentral Alaska, Alaska Peninsula, and small coal fields of Alaska have been previously included in the Alaska portion of the NCRDS.

In the course of gathering information to expand the NCRDS database of coal quality and stratigraphic data for Alaska, the need for collecting new coal samples and current stratigraphic examinations was recognized. The most frequent problems encountered were lack of accurate outcrop and coal sample locations, suspect coal quality analyses, and insufficient stratigraphic control. This was particularly evident in (1) the Copper River Field and associated Summit and Wrangell Districts, (2) the Nulato Coal Field, and (3) the West and East Kobuk Coal Fields of the Kobuk Basin. These areas are relatively unexplored and their coal quality and stratigraphic context are poorly known, yet they contain a number of communities that currently import costly diesel fuel to provide home heating and electrical power generation. The communities are Glennallen, Copper Center, and Gakona (Copper River Field); Nulato, Galena, Kaltag, and Koyukuk (Nulato Field); and Ambler, Kiana, Kobuk, and Shungnak (Kobuk Fields). A solid fuel or coalbed gas alternative for these communities would help avoid costly and environmentally damaging fuel spills while also providing a potentially cost-effective fuel alternative to meet energy needs. The "New Coal Resource Data for Copper River, Nulato, and Kobuk Coal Fields" NCRDS project will help alleviate the lack of data for these coal fields by providing significant new coal quality data and accurate stratigraphic information. This information is essential for meaningful evaluations of the coal resources in these areas.

In June 2000, DGGS staff conducted field examinations of coal outcrops within and along the perimeter of the Copper River Basin. Coal samples were collected from



the eastern Matanuska Field and from water-well drill cuttings (lignite) in the Lake Louise area in the center of the Copper River Field. These coal samples have been submitted for proximate, ultimate, and trace element analyses and selected samples will be submitted for gas isotherm studies. Products from this project are: (1) encoded and formatted coal resource data of new samples submitted to the USGS in their USTRAT and USALYT computer files for inclusion into the Alaska coal database, and (2) a final report detailing coal resource data for each of the coal fields. With continued funding for the DGGS-USGS cooperative effort in subsequent years 2001 and 2002, DGGS will conduct field studies designed to collect new data for the Nulato and Kobuk River fields, respectively.

COALBED METHANE FOR RURAL ALASKA ENERGY

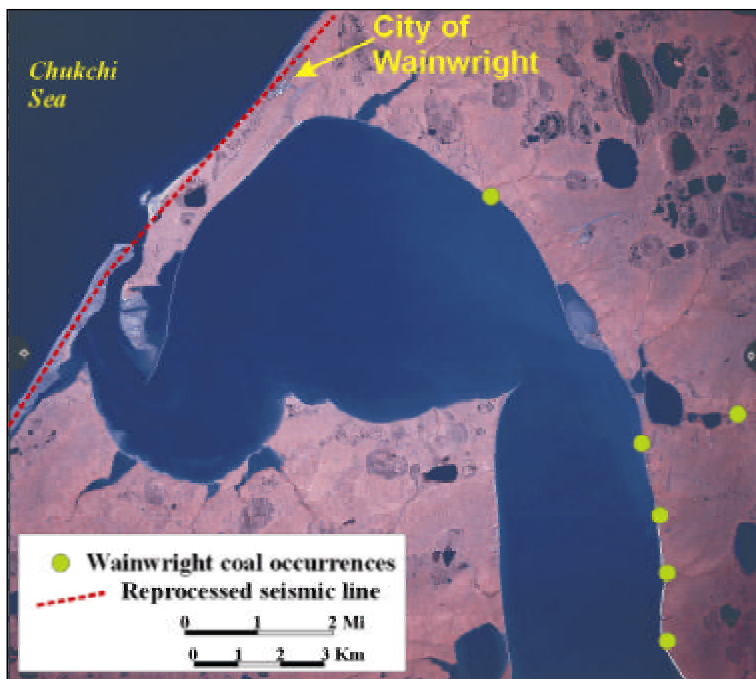
Contact: James G. Clough, Energy Resource Section, (907) 451-5030, jim@dnr.state.ak.us

The Division of Geological & Geophysical Surveys (DGGS) is evaluating the potential for local sources of coalbed methane to meet Alaska's rural energy needs in communities situated on or near coal basins. The presence and quantity of producible coalbed gas in these basins remains unknown and untested until test drilling can assess the quantity and quality of this resource. Coalbed methane can be locally produced and consumed using shallow well fields and short pipelines. This relatively inexpensive, clean coalbed methane could have considerable impact in villages that are now isolated from the power grid by reducing pollution problems from existing diesel generators, making a local gas production company possible, and allowing viable industrial development in areas that now use subsidized or imported energy.

DGGS, in cooperation with the U.S. Geological Survey (USGS), is taking the lead role in evaluating Alaska's remote coal basins for their shallow coalbed gas potential and is focusing on three sites that have the highest potential for coalbed gas: (1) Wainwright in the western North Slope, (2) Fort Yukon in the Yukon Flats, and (3) Chignik area communities on the Alaska Peninsula.

In July 1999, DGGS and USGS staff collected surface outcrop data from coal seams in the Wainwright and Chignik areas. Coal quality analyses along with coal cleat data and gas isotherm studies suggest that subsurface coals at these locations have favorable methane gas generation and holding capacity. Similar tests of coal core obtained from a 1994 climate hole drilled at Fort Yukon suggest similar favorable conditions for coalbed gas exists beneath the community. Available seismic data from the Wainwright area was reprocessed and interpreted by the USGS to evaluate the coal at shallow depths beneath the community. DGGS has entered into a cooperative research agreement with the Kansas Geological Survey to conduct a shallow seismic study this winter at Fort Yukon to evaluate the lateral continuity and thickness of coal seams beneath that community.

Following the completion of site assessments during FY01, the next step is to drill a minimum of two wells per site. The first well would be used for determining the stratigraphic position of coals for subsequent coring in the nearby second well. Coals in the second well would then be cored and measured for gas content by canister desorption. Following coal sample gas desorption tests, the two wells are then used for hydrologic testing by pumping one well and monitoring water table response in the other well. Environmental concerns are assessed



by chemical analysis of the coalbed water produced during these tests. The data gathered by this project will quantitatively estimate the gas in place, pumping requirements for production, and the disposal requirements for the produced water.

DGGS is currently in discussions with the U.S. Department of Energy, Los Alamos National Laboratory to develop coiled-tubing microhole drilling technology that will have the capability to drill to depths of 3,500 feet at approximately one-third the cost of conventional coalbed gas drilling, estimated to be as high as \$1.8 million per site. The University of Alaska will participate with DGGS, Los Alamos, and the USGS in the development and implementation of this new technology.

NORTH SLOPE REGIONAL MAP COMPILATION

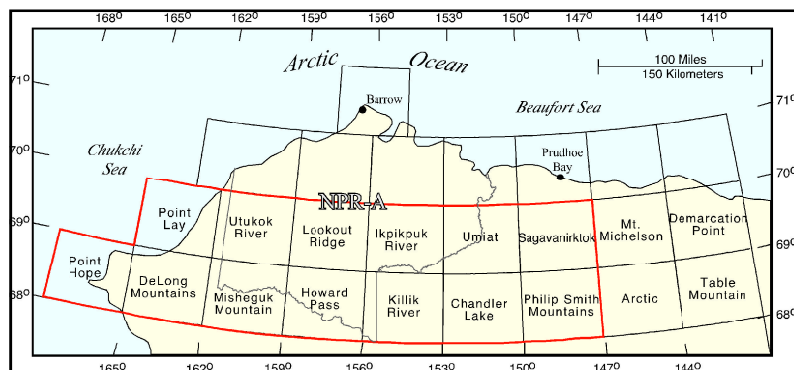
Contact: Charles G. "Gil" Mull, Energy Resource Section, (907) 451-5031, gil@dnr.state.ak.us

The purpose of this project is to compile existing information and produce digital files for a modern suite of 13 geologic maps of the foothills and northern flank of the Brooks Range at a uniform scale of 1:250,000. The maps will incorporate modern stratigraphic nomenclature and consistent style of structural annotation. This mapping will be the basis of a new revised geologic map of the North Slope.

Currently available published mapping of the North Slope has been carried out over a period of over 50 years by numerous geologists from many separate USGS and DGGs projects. The maps have been published at a variety of scales ranging from 1:20,000 to 1:500,000 using a wide variety of stratigraphic nomenclature, some of which has long been obsolete. Aside from the 1:1,000,000-scale map of Alaska published by the USGS in 1980, there is no uniform scale geologic map available for the entire North Slope. The initial basis of the new compilation will be two map suites containing seven 1:250,000-scale and six 1:125,000-scale geologic maps provided for our use by the oil industry as a starting point for the new compilation. Because these two suites of maps were originally compiled at roughly the same time by the some of the same geologists, the nomenclature and style of annotation is relatively consistent, and presents a uniform starting point for revision.

checking of the digitized Chandler Lake Quadrangle was completed, and the revisions will be incorporated into the map during FY2000. The USGS has completed digitizing the Chandler Lake, Umiat, Ikpikpuk River, Lookout Ridge, Utukok River, and Point Lay quadrangles, and revision of the Umiat Quadrangle is in progress. Preliminary maps will be released by the USGS and DGGs in electronic format. DGGs will publish hard copy maps as they are completed.

A priority list and tentative schedule for release of the individual quadrangle maps is shown above. Responsibility for digitizing and revision of specific quads will be agreed upon by the USGS and DGGs based upon priorities and availability of funding and personnel.



The project is being carried out in cooperation with the U.S. Geological Survey, which has begun digitizing the suite of maps. The digital files will then be revised, where necessary, by DGGs personnel working in close collaboration with the USGS to insure uniformity in nomenclature and structural annotation from quadrangle to quadrangle. During the 2000 field season, final field

Quadrangle	FY release
Umiat	2000
Ikpikpuk River	2000
Chandler Lake	2000
Sagavanirktok	2001
Lookout Ridge	2001
Utukok River	2001
Point Lay	2001
Killik River	2001
Howard Pass	2002
Philip Smith Mtns.	2002
Point Hope	2002
DeLong Mtns.	2002
Misheguk Mtn.	2002

HOLITNA BASIN ENERGY RESOURCE STUDY

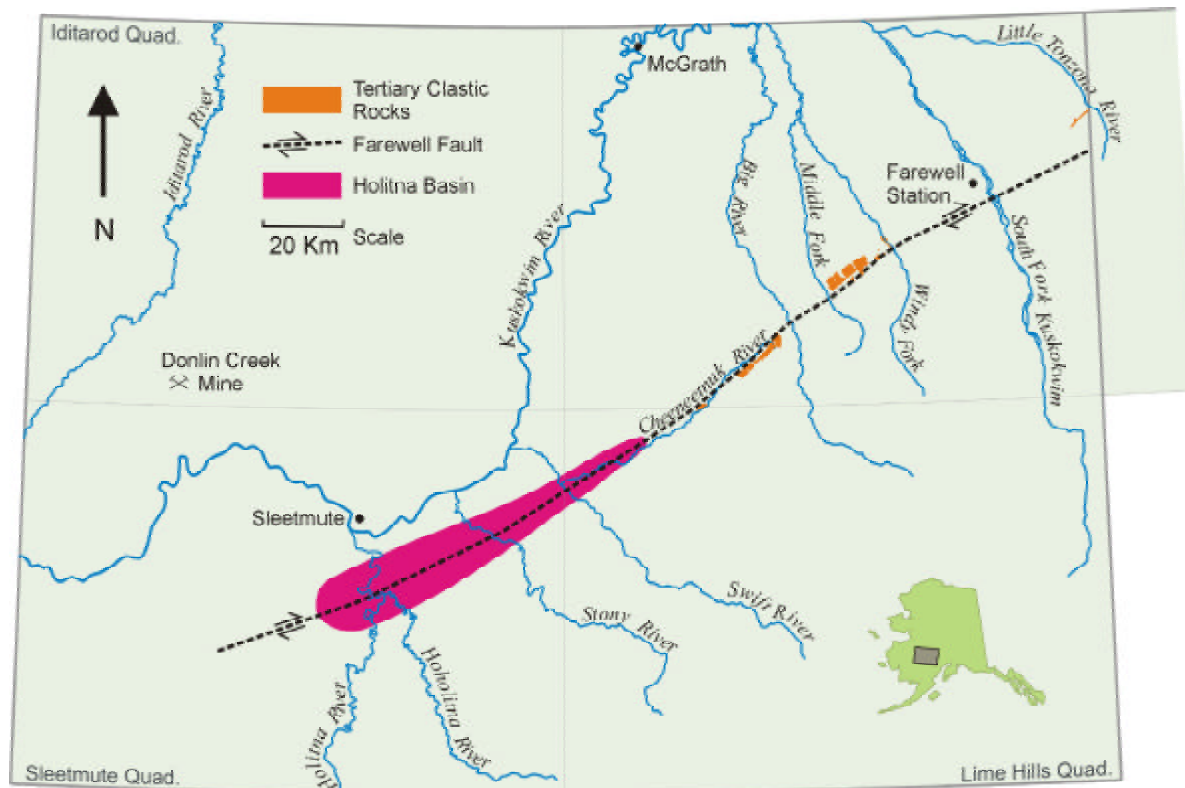
Contact: David L. LePain, Energy Resource Section, (907) 451-5011, davele@dnr.state.ak.us

The Division of Geological & Geophysical Surveys (DGGs) is conducting a one-year study to evaluate the potential for gas in Tertiary strata of the Holitna basin. A local source of gas in the Holitna basin would meet the needs of local communities and support development of nearby mineral resources, such as the Donlin Creek Mine. Little detailed information is available regarding the geology of the basin, which discourages future exploration of the basin's energy resources.

The Holitna basin is a subsurface strike-slip basin located south of the Kuskokwim River, near the village of Sleetmute. Gravity data suggest that the basin contains up to 6,000 meters of Tertiary age sedimentary rocks. The location of the basin astride the Farewell fault suggests that its formation and fill are related to right-lateral strike-slip motion on the fault. No exposures of the basin-fill exist, making direct evaluation of its gas potential possible only through an expensive drilling program. However, exposures of Tertiary age coal-bearing rocks are present northeast of the Holitna basin, along a north-east-trending belt that straddles the Farewell Fault. During the FY01 field season DGGs conducted detailed stratigraphic studies of Tertiary strata in this belt to char-

acterize the reservoir quality of sandstones and conglomerates, and the gas potential and thermal maturity of coals and carbonaceous shales. In addition to fieldwork, DGGs is reinterpreting high-resolution aeromagnetic data of the region and is pursuing the purchase of a detailed gravity survey of the region. Both of these geophysical datasets will result in a better understanding of the origin, deep structure, and sedimentary fill of the Holitna basin. DGGs is also evaluating surface geochemical survey techniques to complement the geophysical and outcrop datasets. The dataset resulting from this project will allow DGGs to make meaningful general conclusions regarding the gas potential of the Holitna basin. The dataset and DGGs's summary report might help lower the risk associated with more expensive late-stage exploration of this remote frontier basin.

Products from this project will include a report summarizing the reinterpreted high-resolution aeromagnetic data, a report on the interpretation of the detailed gravity survey, and a summary report on the gas potential of the Holitna basin that incorporates all available data and makes recommendations, if appropriate, for future work.



Outcrop belt from Gilbert (1981); Dickey (1982); and Bundtzen (1998)

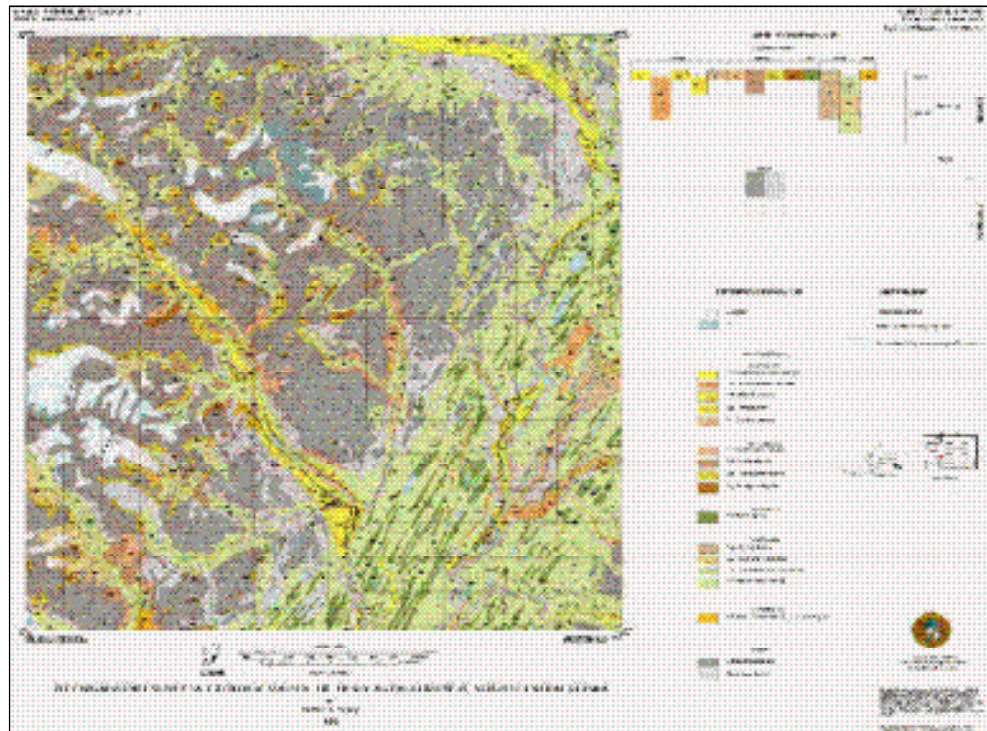
SURFICIAL AND ENGINEERING GEOLOGY OF THE CHULITNA MINING DISTRICT

Contact: DeAnne S. Pinney, Engineering Geology Section, (907) 451-5014, deanne@dnr.state.ak.us

DGGS is completing a field-based program to provide ground truth for airborne geophysical surveys flown in the Chulitna mining district in 1995. In order to explore new opportunities for development in the Chulitna mining district, it is critical that the State have an up-to-date inventory of the geologic resources of the area to guide planning activities and identify key features of potential interest.

DGGS efforts have focused on determining and understanding the geologic environments of the Chulitna mining district, especially with respect to gold mineralization and deposition. As a corollary to this, the Engineering Geology section of DGGS has focused on mapping the surficial deposits of the area in order to understand the genesis of the landscape in which the mineralized zones are found, to assess these cover deposits and other rock units for their potential as construction materials in the event of further economic development or infrastructure needs in the region, and to identify possible geologic hazards that could pose a danger to human life and property should there be such increased development in the district.

The products of this project are a series of geologic-framework maps at 1:63,360 scale describing the surficial geology, construction materials resources, and potential geologic hazards of the area. Maps of the Healy A-6 Quadrangle, which comprises the heart of the Chulitna mining district, have been completed and released in fulfillment of DGGS contracts with the federally supported STATEMAP program. The figure shown above is the surficial-geologic map submitted as part of the project deliverables. Current work is focusing on the completion and publication of maps of an expanded area that includes the entire mining district and encompasses all of the area that was flown in the geophysical survey. We are using the DGGS Geographic Information System (GIS) to generate these maps, and all data for the project will ultimately be stored and made available in a geographically referenced relational database. We hope to be able to serve this data on the Worldwide Web upon the completion of the project.



SURFICIAL AND ENGINEERING GEOLOGY OF THE SALCHA RIVER-POGO AREA

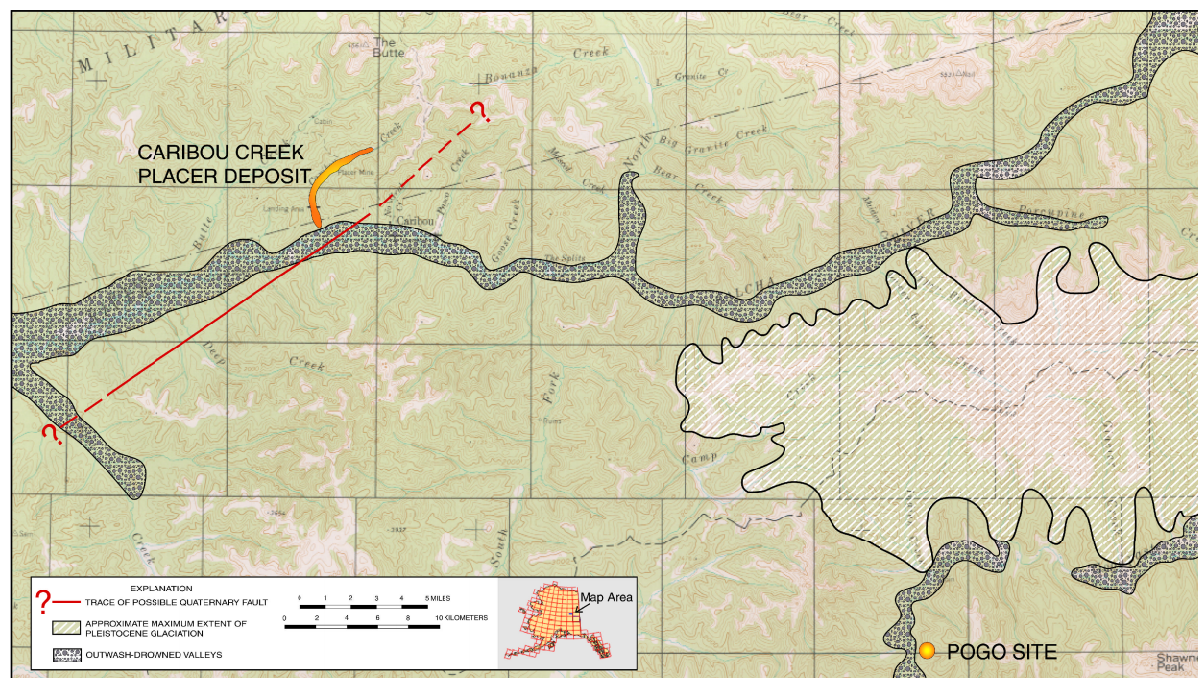
Contact: DeAnne S. Pinney, Engineering Geology Section, (907) 451-5014, deanne@dnr.state.ak.us

DGGS has begun the first year of a three-year field-based program to provide ground truth for airborne geophysical surveys flown in the Salcha River area in 1999. This area is receiving a great deal of attention from the mining community due to the discovery of a potentially world-class gold deposit at the Pogo site (see map). In order to explore new opportunities for development in the Salcha River-Pogo area, it is critical that the state have an up-to-date inventory of potential geologic resources to guide planning activities and identify key features of potential interest.

DGGS efforts are focusing on determining and understanding the geologic environments of the Salcha River-Pogo area, especially with respect to gold mineralization. As a corollary to this, the Engineering Geology section of DGGS will be mapping the surficial deposits in order to understand the genesis of the landscape in which the mineralized rocks are found, to assess the cover deposits and other rock units for their potential as construction materials in the event of further economic development or infrastructure needs in the region, and to identify possible geologic hazards that could pose a danger to human life and property should there be increased development in the area. The figure shown above illustrates the approximate maximum extent of Pleistocene glaciation in the mountains immediately north of the Pogo site. We hypothesize that the valleys of the Goodpaster and Salcha rivers were originally carved by

ancient, pre-Pleistocene glaciers and were subsequently drowned by large influxes of Pleistocene outwash sediments that filled the valleys and formed the broad, flat-bottomed valley floors we see today. Our present working hypothesis for the apparent absence of gold placers associated with the gold-rich Pogo deposit is that any existing placers may be deeply buried under the outwash fill in the Goodpaster River valley. This may also explain the seemingly abrupt truncation of the Caribou Creek placer deposits at the junction with the Salcha River. Also shown is a possible Quaternary fault that appears to offset loess deposits south of Butte Creek. This is significant in that no faults of such young age have been previously documented in the area. The implication of such recent tectonic activity has yet to be explored, but will necessarily change our picture of the geologic environment of the Salcha River-Pogo area.

The anticipated products of this project are a series of geologic-framework maps at 1:63,360 scale describing the surficial geology, construction materials resources, and potential geologic hazards of the area. We will be using the DGGS Geographic Information System (GIS) to generate these maps, and all data for the project will ultimately be stored and made available in a geographically referenced relational database. We hope to be able to serve this data on the World Wide Web upon completion of the project.



GEOLOGIC GROUND-TRUTH INVENTORY OF THE PETERSVILLE (YENTNA) MINING DISTRICT GEOPHYSICAL SURVEY TRACT

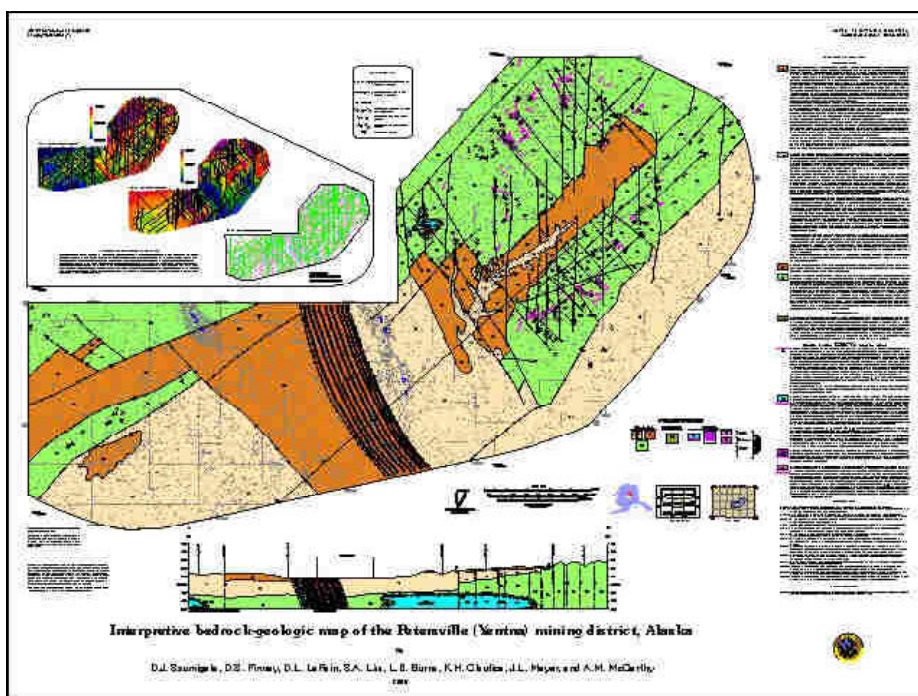
Contact: DeAnne S. Pinney, Engineering Geology Section, (907) 451-5014, deanne@dnr.state.ak.us

DGGS continues work on its field-based program to provide ground truth for airborne geophysical surveys flown in the Petersville (Yentna) mining district in 1996. The Petersville district is extensively utilized by a wide spectrum of users, including miners, tourists, snowmachiners, hunters, and fishermen. Legislation signed by Governor Knowles has established two tracts of land for recreational gold mining by the general public at Petersville, an action that will undoubtedly substantially increase the number of visitors to the area. The proposed new Denali Visitors' Center at the Tokositna site in the northeastern part of the district has also made the area the focus of much recent public interest. In light of the new opportunities for development in the Petersville mining district, it is critical that the State have an up-to-date inventory of geologic resources to guide planning activities and identify additional areas of potential interest.

DGGS efforts have focused on determining and understanding the geologic environments of the Petersville mining district, especially with respect to gold mineralization and deposition. We had hoped to use detailed mapping and petrographic analysis to subdivide the rocks of the Kahiltna group that dominate the bedrock geology of the district, but poor weather and lack of exposures made this task impossible. The geophysical data have been critical to our efforts to extrapolate geologic con-

tacts beneath the cover that dominates the majority of the study area, as well as into areas we were unable to reach on the ground.

The products of this project are a series of geologic-framework maps at approximately 1:63,360 scale and reports describing the mineral potential of the prospects surveyed. To date, the completed products include maps of sample locations with results of geochemical analyses, a map of glacial ice limits with a discussion of the implications for placer deposits, a surficial-geologic map which was awarded first place in digital cartography at the annual Alaska Surveying and Mapping Conference, and a recently-completed interpretive bedrock-geologic map (shown above). This map is currently being digitally combined with the surficial-geologic map to generate a comprehensive geologic map of the district. We are using the DGGS Geographic Information System (GIS) to generate these maps and will subsequently produce a derivative engineering-geologic map of the district, including prospective construction-materials sites and potential geologic hazards. All data for the project will ultimately be stored and made available in a geographically referenced relational database. We hope to be able to serve this data on the World Wide Web upon completion of the project.



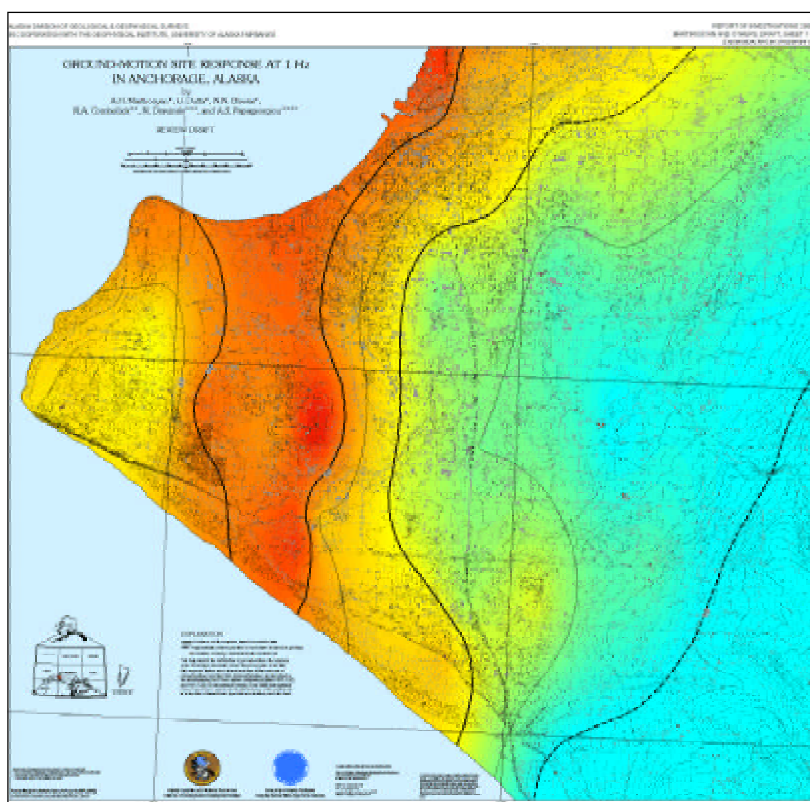
ANCHORAGE GEOTECHNICAL PROJECT

Contact: Rod Combellick, Engineering Geology Section, (907) 451-5007, rod@dnr.state.ak.us

DGGS has finished compiling geotechnical borehole data and deep water-well logs for the Anchorage area and has begun to prepare engineering-geologic map products based on these data. We have built a GIS database index of well over 4,000 borehole and water-well logs from all known public and private sources. Of these 4,000+ borehole logs, we have entered downhole technical data for about 2,500. To the best of our knowledge, the database is complete for all geotechnical boreholes greater than 50 ft deep and all available digital well-log data for water wells greater than 100 ft deep. In late 1999, we produced a simplified geologic map and cross sections of central and east Anchorage (DGGS Preliminary Interpretive Report 1999-1) and are currently in the process of extending the map and cross sections westward to produce a final map and cross sections of the entire city.

In conjunction with this project, we are collaborating with the University of Alaska Geophysical Institute (UAGI) in a seismic microzonation project to combine geological and geophysical data in the preparation of maps to aid planners and developers in the design and construction of more earthquake-resistant facilities. Subsurface geologic information has proven highly beneficial in the processing and interpretation of seismic data collected by UAGI. The first map products being developed by this project are seismic site-response maps that show the variation in ground-motion amplification that can be expected in Anchorage for three different shaking frequencies. An example of one of these draft maps is shown here, depicting expected site response for shaking at a frequency of 1 Hz (one cycle per second). This is approximately the dominant frequency of shaking that occurred in Anchorage during the 1964 magnitude 9.2 earthquake. Highest shaking amplification is shown in red for areas of thick, soft soils, while zero amplification is shown in blue for areas of bedrock and shallow, hard soils. The results are consistent with

the known pattern of ground shaking in 1964 and clearly reflect what we now know about the subsurface geology. Other maps in the set portray site response at 0.35 Hz and 5 Hz. The data shown on these maps and the shaking frequencies selected for analysis correspond to the seismic provisions of the latest building codes. Consequently, structural-design professionals can use these maps in conjunction with the building codes during the design process and for guiding more detailed site-specific analyses. The site-response maps and accompanying text will be published in fall 2000 as a DGGS Report of Investigations.



An additional map being prepared collaboratively with UAGI is a seismic soil-type map, which also corresponds to provisions of the latest seismic building code and will be published during FY2001. DGGS has requested funding from the U.S. Geological Survey (USGS) to develop a liquefaction-susceptibility map using newly compiled data in the borehole database. DGGS's participation in these projects has been partially supported by the USGS National Earthquake Hazards Reduction Program.

GENERALIZED EARTHQUAKE HAZARD MAPPING FOR SOUTHERN ALASKA COASTAL DISTRICTS

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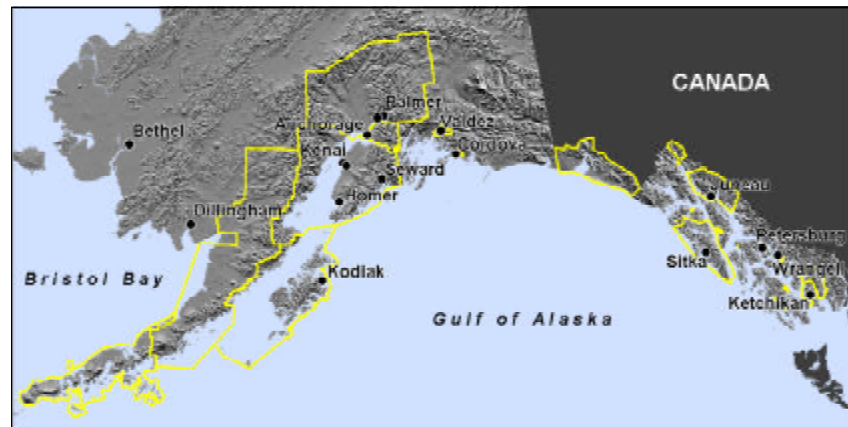
As part of the Enhancement Grants component of the Alaska Coastal Management Program, DGGs was successful in obtaining funding from the Division of Governmental Coordination to prepare generalized earthquake hazard maps of coastal districts in southern Alaska. This two-year project will provide geohazards information to help coastal districts implement the geophysical hazard standard (6AAC 80.050) and to update the resource inventory section of district plans. Products of the work will be maps of Quaternary faults and earthquake ground-shaking hazards for coastal districts in southwestern, southcentral, and southeastern Alaska at scales appropriate for area planning and preliminary project evaluation.

A significant difficulty for Alaska coastal districts in implementing the geophysical hazard standard (6AAC 80.050) is that there are very few reliable maps showing the location and severity of hazards. Detailed hazard maps of large areas are slow in coming because the field efforts necessary to collect the required data are time consuming and expensive. However, there is now sufficient available regional information on active faults, earthquake frequencies, and ground-shaking potential, as well as GIS-based modeling methodology to prepare generalized maps of these hazards for the coastal districts in which the hazards are significant. Preparation of these earthquake-hazard maps, based on existing information, is the overall objective of this project. No fieldwork is planned.

The results of this project will improve the ability of districts and permit applicants to address the geophysical hazard standard in southwestern, southcentral, and southeastern Alaska. The intent is to make the best use of available geohazards information in a reasonable time without conducting costly additional fieldwork. Consequently, the maps will be necessarily generalized. By having earthquake-hazard information at the permit-application and planning stages, applicants and districts will be better equipped to make wise development decisions and thereby reduce future losses and casualties from earthquakes. The information can be used to update

coastal district resource inventories and may lead to more specific enforceable policies for mitigating geophysical hazards.

The earthquake-hazard maps will be made available as registered GIS images as well as on paper. The format, scale, and types of information to be portrayed will be determined in consultation with the districts during the first year of the project. Because detailed geologic and subsurface data are still lacking in many areas, the maps will not portray hazards from earthquake-induced landsliding. The maps will also not address tsunami inundation or volcanic hazards, nor will they replace



Coastal districts in southwestern, southcentral, and southeastern Alaska for which DGGs will develop generalized earthquake-hazard maps.

existing, more detailed earthquake-hazard maps that are currently available or in preparation for parts of the Municipality of Anchorage.

Two series of workshops will be held with the coastal districts (southeastern, southcentral, and southwestern). The first series of workshops will be held early in the first year of the project with the purpose of explaining the project to district personnel and obtaining their input regarding desired map scales, what areas of larger districts to include, format, and content (such as base-map detail and hazard depiction). A second series of public education/outreach workshops will be held near the end of the second year of the project with the purpose of presenting the draft earthquake-hazard maps, explaining their uses and limitations, and obtaining comments from participants that will then be used to make final revisions before publication.

MAPS AND DATABASE OF QUATERNARY FAULTS AND FOLDS

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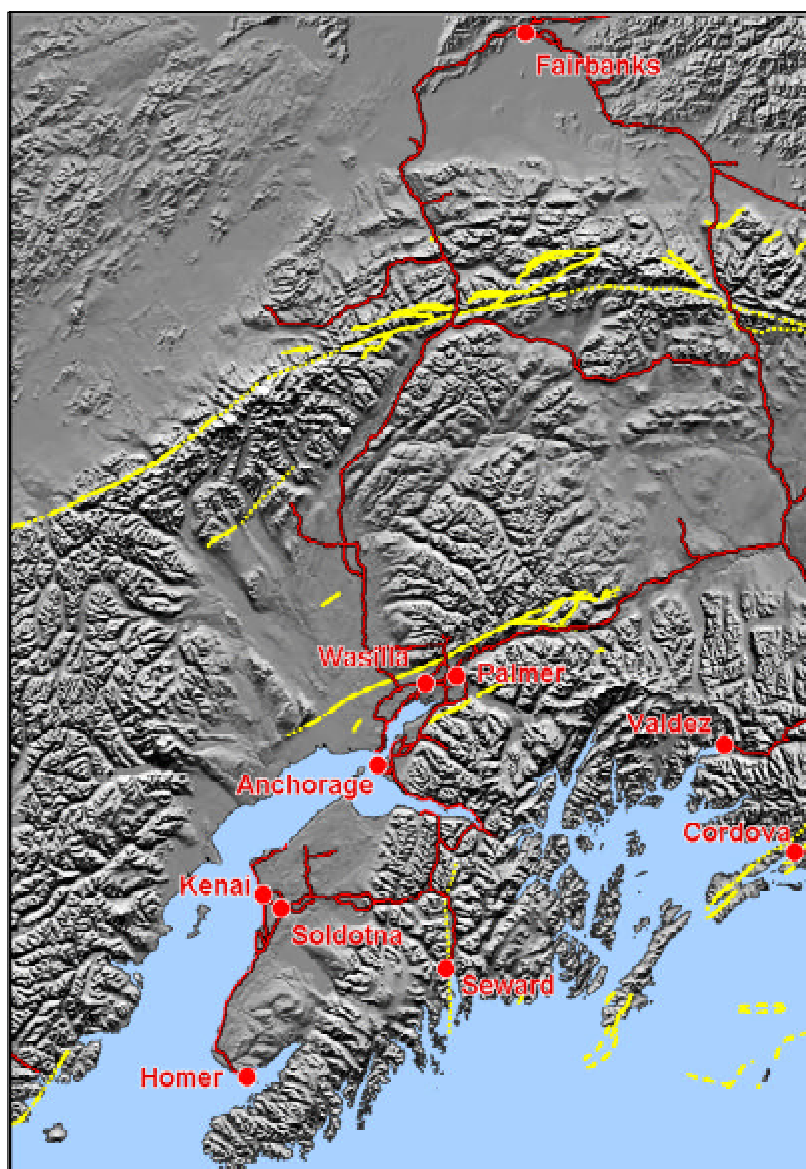
Geologic maps show that there are thousands of faults in Alaska. However, only a fraction of these have been active in the recent geologic past; most have not undergone displacement for millions of years. Faults that are of concern as possible sources of earthquakes are those that show evidence of activity during the Quaternary period, roughly the past 2 million years. Active faults are those that have had historic seismicity or show geologic evidence of displacement during the Holocene epoch, approximately the past 10,000 years. A recent neotectonic map of Alaska shows that there are at least 140 surface faults with evidence of activity during the

Quaternary period. Although this excellent map provides an invaluable reference on active faulting in the state, it was compiled at a scale of 1:2,500,000, which is not meant for use in project planning at the local level. Additionally, the map does not provide some important information available for many faults, such as orientation, slip rate, or earthquake recurrence interval.

The U.S. Geological Survey has initiated a cooperative project with DGGs to compile data on active faults and folds in Alaska in a standard GIS format. With funding provided by USGS, DGGs has conducted an extensive

literature survey to record all published information on faults and folds that show geologic or seismic evidence of activity during the Quaternary period. DGGs will digitize the fault traces and fold axes at 1:250,000 scale and record associated attribute data in a GIS database. The resulting report and maps will facilitate evaluation of faulting and earthquake hazards for future development projects in the state.

This project has four tasks. The first task, to conduct a comprehensive literature search for pertinent published materials on Quaternary faults and folds in Alaska, has been completed. The second task, to complete text-based descriptions of these structures using a nationally established format and building on USGS-supplied preliminary data, is in progress. The two remaining tasks are: (1) compile fault traces and fold axes in GIS with associated attributes according to national guidelines, and (2) revise text files and compiled map data following technical review comments. The project will be completed by the end of FY2001.



Quaternary faults in southcentral Alaska

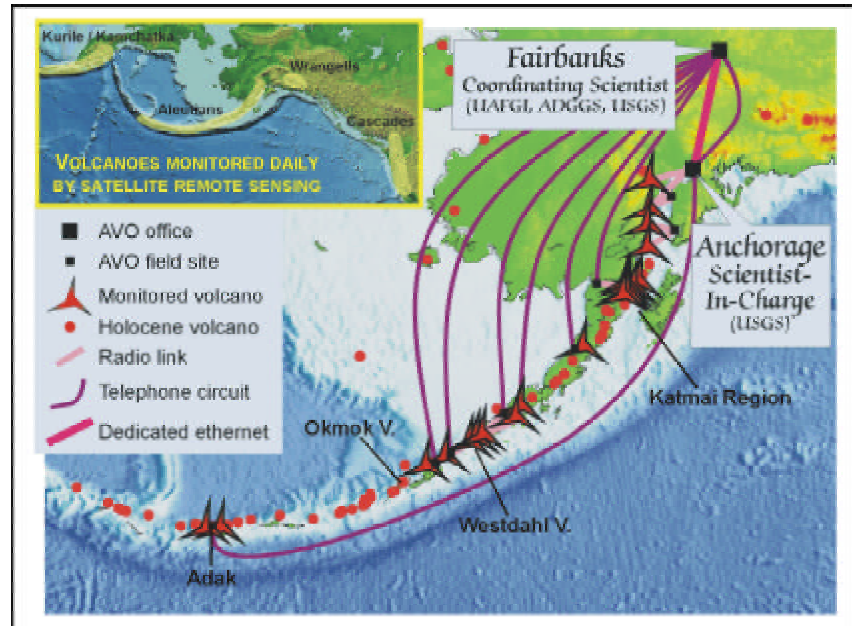
ALASKA VOLCANO OBSERVATORY

Contact: Chris Nye, Engineering Geology Section and AVO, (907) 474-7430, cnye@giseis.alaska.edu

The Alaska Volcano Observatory (AVO) is a multi-agency program that uses state, federal, and university resources to monitor and study Alaska's hazardous volcanoes, predict and record eruptive activity, and implement public safety measures. AVO is a cooperative program of the Alaska Division of Geological & Geophysical Surveys, the U.S. Geological Survey, and the University of Alaska Fairbanks Geophysical Institute.

Networks of seismometers are the heart of AVO's volcano monitoring. These networks consist of about half a dozen instruments clustered about potentially hazardous volcanoes. Several instruments are needed close to each volcano to accurately record and locate the very small earthquakes associated with volcanic eruptions. Changes in the locations of earthquake hypocenters over months and weeks provide very important information about impending eruptions. In the last five years AVO has rapidly expanded the number of monitored volcanoes using \$2 million in new annual funding provided by the Federal Aviation Administration. The new funding is a direct response to increasing air traffic in the north Pacific and the hazards that volcanoes present to that traffic. Over the past four years the number of monitored volcanoes has risen from 4 to 21 of the 40+ active Alaska volcanoes. During FY00 the monitoring system on Kanaga Volcano, near Adak, was completed and sites throughout the arc were maintained.

Satellites extend AVO's capabilities to all Alaska volcanoes as well as the particularly active volcanoes of Kamchatka in the Russian far east, and those in the northern Kurile Islands. These remote, unmonitored, or poorly monitored volcanoes also pose a very real hazard to aviation in American-controlled airspace. Today AVO automatically processes hundreds of detailed subsections of satellite data and scans those data twice daily for thermal anomalies that indicate volcanic unrest, and may precede eruptions by weeks or months. Some eruptions,



This map illustrates the reach of AVO volcano monitoring. As of September 1999, 22 of 43 active Alaska volcanoes are seismically monitored, and 80+ volcanoes in Alaska, Kamchatka, the northern Kuriles, and the western conterminous United States are monitored twice daily using close inspection of satellite imagery.

such as the 1997 eruption of the unmonitored volcano Okmok, were first detected using satellite data. Satellites are also used to track volcanic plumes as they drift downwind. Most recently, AVO monitored a moderate plume from Sheveluch volcano in Kamchatka, which erupted on August 29, 2000, and drifted into U.S.-controlled airspace.

Volcano hazards reports and geologic maps provide the "patient history" to complement "vital signs" collected by geophysical networks. These reports and maps document the past history of each volcano, which helps anticipate the course and nature of future eruptions. Hazards reports also identify local infrastructure that may be at risk. The Hazard report for Makushin was finished, and a draft of those for Shishaldin and Spurr completed. Field work and draft geologic maps at Shishaldin and Spurr have been completed.

DGGS plays a vital role in AVO. DGGS is the smallest partner in AVO, contributing less than 10 percent of the personnel. Over 95 percent of DGGS's participation in AVO is funded by two cooperative agreements with the USGS, only one of which has dates that coincide with

the state fiscal year. These cooperative agreements describe DGGS's tasks within AVO. Summaries and FY00 progress are below:

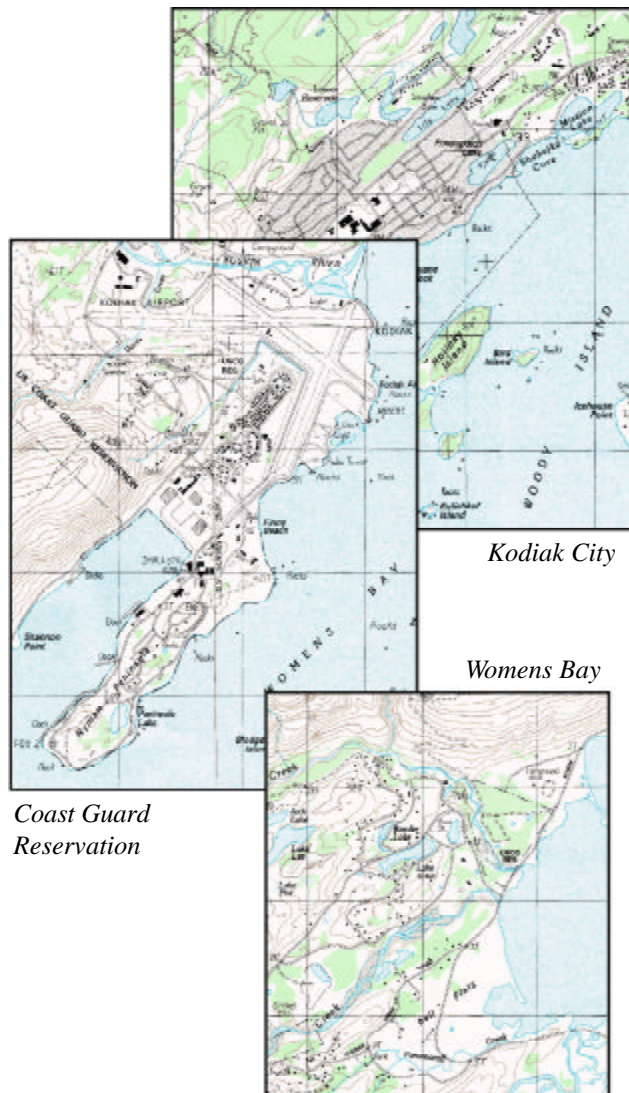
- **Helicopter logistics.** DGGS manages \$325,000 annually for helicopter procurement for all major AVO projects. In FY2000 this included contracts for field work based out of Adak, Dutch Harbor, False Pass, Cold Bay, Port Heiden, King Salmon, Homer, Anchorage, and Glennallen. Having all the helicopters contracted by a single agency results in significant budgetary and logistic efficiencies. As part of managing the helicopter budget DGGS is responsible for the final fine-tuning of the schedules.
- **Geologic and volcanic hazards studies at Shishaldin and Spurr volcanoes.** DGGS provided the team leader for a multi-agency team responsible for producing the geologic map and volcanic hazards study of Shishaldin Volcano. Shishaldin is one of Alaska's three most active volcanoes, and was seismically instrumented by AVO in 1997. Geologic fieldwork was completed in FY99 and a draft geologic map was prepared. Fieldwork at Spurr has been ongoing for 15 years. The final hazards report and geologic map will be completed in FY00.
- **AVO World Wide Web site.** DGGS was the original creator of the AVO web site several years ago, and continues to be the site manager. DGGS has the primary responsibility for producing and maintaining the site (<http://www.avo.alaska.edu>), including all the HTML coding and graphics manipulation and most of the design. In FY99 we launched the third version of the public page, with more intuitive organization, and much more content. A major new addition was individual pages for each active volcano based on text and figures, a new USGS catalogue with photographs, newly generated color maps, additional eruption narratives, and expanded bibliographies. This created what are essentially atlas pages for at least the historically active volcanoes. We are also beginning to create a library of PDF files to facilitate distribution of richly formatted AVO print publications. This now makes the AVO web site the best place for one-stop-shopping for information on Alaska volcanoes. DGGS also oversees the AVO internal web site that displays complex near-real-time seismological and satellite data over the web, making distributed monitoring possible, instead of monitoring only from within the lab. During FY00 the site will undergo a major overhaul aimed at producing increased ease of navigation through the site.
- **Presentation and distribution of geospatial data.** AVO is producing a folio of GIS (ArcInfo) geologic maps and map-based hazard reports on individual volcanoes. The projects that produce these products also usually have many kinds of spatially referenced data, including sample descriptions, geochemistry, age data, stratigraphic columns, etc. Traditionally these are distributed as either paper products (map plus text and tables) or as ArcInfo coverages. Paper products severely limit the ability of the end user to manipulate, sort, query, or otherwise interact with all aspects of the data. DGGS members of AVO will seek new methods for presenting geospatial data that will allow a high level of interactivity for relatively unsophisticated computer users. This is an ongoing task.
- **Geochemical database:** DGGS provides oversight and coordination of contracting for whole-rock geochemical data for all of AVO. This oversight ensures that an internally consistent database continues to evolve among all AVO sub-projects.

TSUNAMI INUNDATION MAPPING

Contact: Rod Combellick, Chief, Engineering Geology Section, (907) 451-5007, rod@dnr.state.ak.us

With funding from Congress, the National Oceanic & Atmospheric Administration (NOAA), Federal Emergency Management Agency (FEMA), and U.S. Geological Survey (USGS) initiated the National Tsunami Hazard Mitigation Program in 1997 to assist Pacific states in reducing losses and casualties from tsunamis. The program includes funding for five states (Alaska, Hawaii, Washington, Oregon, and California) to address four primary issues of concern: (1) quickly confirm potentially destructive tsunamis and reduce false alarms, (2) address local tsunami mitigation and the needs of coastal residents, (3) improve coordination and exchange of information to better utilize existing resources, and (4) sustain support at state and local level for long-term tsunami hazard mitigation.

As part of this program, DGGS is participating in a cooperative project with the Alaska Division of Emergency Services (ADES) and the University of Alaska Geophysical Institute (UAGI) to prepare tsunami inundation maps of selected coastal communities. Kodiak is the first community selected for this project. We are producing maps of three areas (Kodiak City, U.S. Coast Guard Reservation, and Womens Bay) to show approximate extent of inundation from large, distant tsunamis and recommended evacuation routes for reaching safe ground. As the result of a conference of local, state, and federal representatives held in 1999, nine additional communities were selected and prioritized for future inundation mapping based on population, tsunami exposure, community interest, and available data. Homer and Seldovia are the next communities for which maps will be prepared after the Kodiak maps are completed.



Various agencies have produced tsunami hazard maps for some communities in the past, based primarily on assumed maximum elevation of wave run-up or, in some cases, on historic tsunami impacts. In this program, inundation maps are being developed using complex computer modeling of tsunami waves as they move across the ocean and interact with the seafloor and shoreline configuration in shallower nearshore water. UAGI is conducting the wave modeling using facilities at the Arctic Region Supercomputing Center. DGGS will use the results of this modeling to construct a Geographic Information System (GIS) database for use in depicting projected inundation limits on suitable base maps. Following preparation of draft inundation maps, ADES and community leaders will develop recommended evacuation routes based on local knowledge of terrain, roads, trails, and structures. DGGS will publish final maps that will display the inundation limits for various modeled tsunamis, recommended evacuation routes, and important facilities.

As of this writing, DGGS has assembled appropriate digital base maps for the three Kodiak project areas (shown above) and is awaiting the results of tsunami wave modeling by UAGI. Because of delays in obtaining the required bathymetric data from NOAA, the computer modeling has been delayed for several months. Maps for the Kodiak area are now expected to be completed by December 2000.

GIS-BASED DIRECTORY OF CONSTRUCTION-MATERIALS PRODUCERS IN ALASKA

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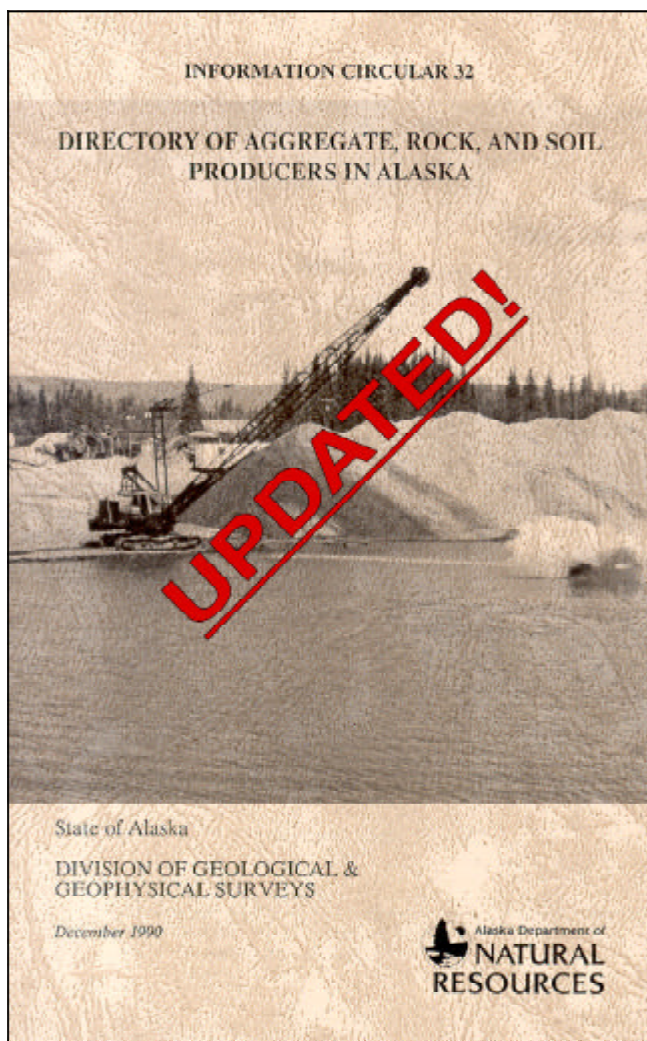
DGGS is compiling a digital, GIS-based directory of current construction-materials producers in Alaska that will include location, commodity, and production data. An important part of this project will be the establishment of a mechanism to maintain and update this data annually so it will remain current through time.

Information Circular 32, “*Directory of Aggregate, Rock, and Soil Producers in Alaska*”, was compiled in 1990 and is presently our most up-to-date catalog of construction-materials producers in the state. Producers and production have changed radically in the intervening decade, and an update of this information is a critical necessity if the State of Alaska is to be a responsible manager and caretaker of its natural resources. Increased development and growing population requires concurrent expansion of infrastructure that will generate an ever-greater need for construction materials throughout the state. A significant corollary to this is the necessity of documenting and tracking the distribution and production rates of developed deposits in order to help predict future trends in demand and output. Relative and absolute production can be useful proxy measures of economic development in a region.

In order to gather the data for this project, the Engineering Geology section of DGGS will be soliciting information from the public and private sectors using a form modified from the one developed for IC 32. The responses will be compiled in a Microsoft Access database and then categorized by commodity and location. We hope this project will elicit a positive and forthcoming response from the production community, although we may need to observe some restrictions on the release of detailed information in order to protect data confidentiality requirements that may be requested by some private-sector producers. Similar requests have been successfully satisfied by DGGS in the publication of the annual minerals report; we anticipate no problems in following suit for this project.

The planned products of this project are: a georeferenced database of location, commodity, and production data; a formal physical and/or digi-

tal catalog of producers including the above data; one or more maps depicting the distribution of production sites (separate or as part of the catalog); and a streamlined system whereby the database and derivative products can be updated annually. We will be using the DGGS Geographic Information System (GIS) to generate many of these products, and all data (barring confidentiality stipulations of cooperating producers) will ultimately be served on the World Wide Web upon completion of the project.



GIS-BASED BIBLIOGRAPHY OF INDUSTRIAL MINERALS SITES IN ALASKA

Contact: DeAnne S. Pinney, Engineering Geology Section, (907) 451-5014, deanne@dnr.state.ak.us

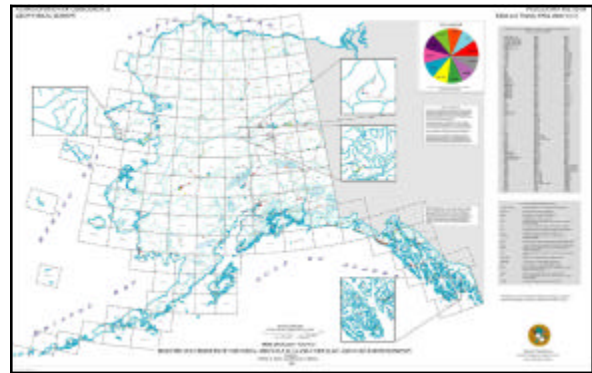
DGGS is updating and expanding the existing GIS-based bibliography of industrial minerals sites in Alaska in order to document and inventory the State's potential economic commodities and make the information available to the public digitally via the Internet and on CD-ROM.

A broad and simple definition of industrial minerals is that they are principally non-metallic (that is, they are not utilized as metals even though the material in question is, strictly speaking, a metallic mineral), non-fuel rocks and minerals. They include a broad range of minerals that are consumed for a wide variety of industrial uses. Industrial minerals are generally regarded as common, simple products that are sold cheaply into local markets, but many are actually quite rare, most are extremely complex, some far exceed the price of the more glamorous metals, and a significant proportion are shipped to markets around the world.

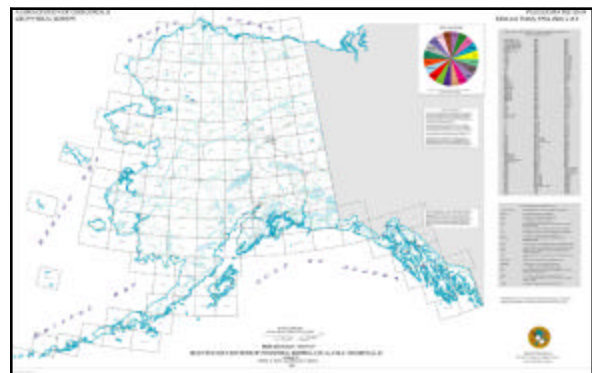
The maps shown at right were released by DGGS in 1995 and summarize the data that had been compiled from the literature on industrial materials resources in Alaska. The GIS database used to generate these maps contains 1,608 records of industrial minerals occurrences documented from 1911 to 1988. The 33 commodities are subdivided into three groups in order to be represented on map sheets: metallic and rare-earth (map 1), including magnesium, titanium, iron, chromium, columbium, vanadium, thorium, uranium, manganese, aluminum, and the rare-earth elements; nonmetallic minerals (map 2), including graphite, wollastonite, gemstones, fluorite, barite, asbestos, mica, zeolites, kyanite, pumice, diatomite, perlite, quartz, clay, gypsum, zirconium, sulfur, silica, phosphate, and calcium; and construction materials (map 3), including sand and gravel and stone.

The Engineering Geology section of DGGS will be focusing on updating this GIS database in FY2001 to reflect any more recently documented occurrences of industrial minerals in the state and to put it into a format that can be readily accessed on the World Wide Web or downloaded from CD-ROM.

Industrial minerals in Alaska represent a resource of potentially significant value that is currently under-exploited, in large part because of access and transportation barriers. Renewed interest in railway expansions to link Alaska with new markets may act as a catalyst for exploration for these commodities, and could open a new chapter in natural resources development in the state.



Map 1. Industrial minerals in Alaska: Metallic and rare-earth



Map 2. Industrial minerals in Alaska: Nonmetallic



Map 3. Industrial minerals in Alaska: Construction materials

SURFICIAL AND ENGINEERING GEOLOGY OF THE FORTYMILE MINING DISTRICT

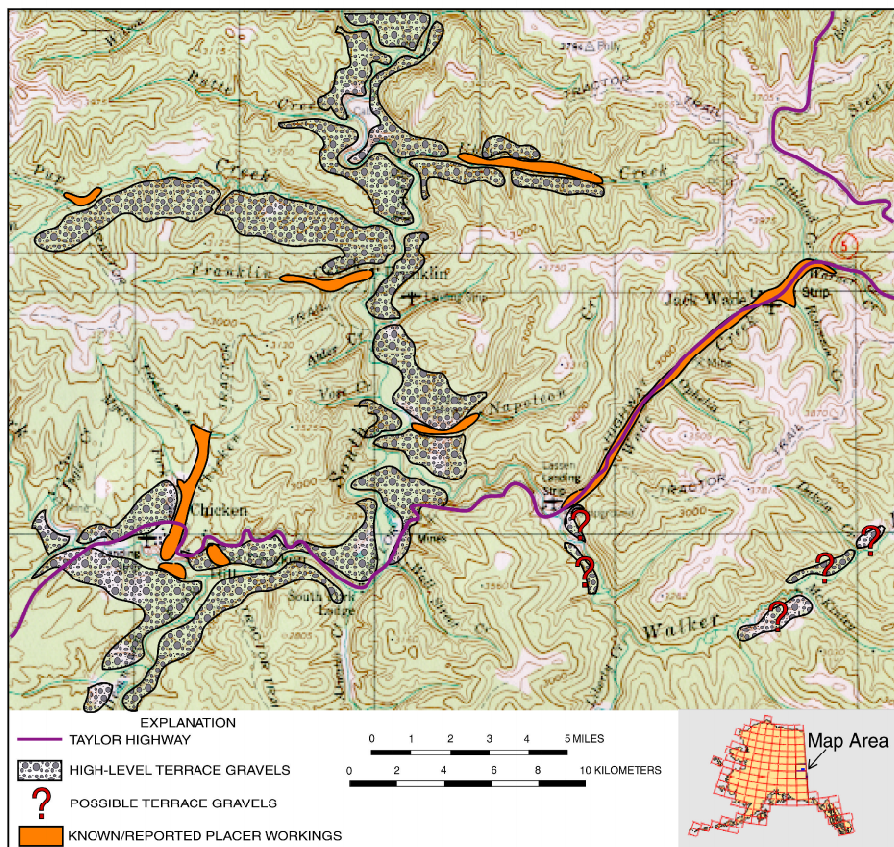
Contact: DeAnne S. Pinney, Engineering Geology Section, (907) 451-5014, deanne@dnr.state.ak.us

DGGS is completing the second year of a three-year field-based program to provide ground truth for airborne geophysical surveys flown in the Fortymile mining district in 1997. In order to explore new opportunities for development in the Fortymile mining district, it is critical that the State have an up-to-date inventory of the geologic resources of the area to guide planning activities and identify key features of potential interest.

DGGS efforts have focused on determining and understanding the geologic environments of the Fortymile mining district, especially with respect to gold mineralization and placer deposition. As a corollary to this, the Engineering Geology section of DGGS has focused on mapping the surficial deposits of the area in order to understand the genesis of the landscape in which the placer gold deposits are found, to assess the cover deposits and other rock units for their potential as construction materials in the event of further economic development or infrastructure needs in the region, and to identify possible geologic hazards that could pose a danger to human life and property should there be such

increased development in the district. The figure shown below illustrates the relative distributions of some modern placers in the area compared to ancient high-level terrace gravels that flank many of the major drainages. Our present working hypothesis is that many of the known placer gold deposits in the Fortymile mining district have been reworked from these older terraces.

The anticipated products of this project are a series of geologic-framework maps at 1:63,360 scale describing the surficial geology, construction materials resources, and potential geologic hazards of the area. Maps of the Eagle A-2 Quadrangle are scheduled to be completed and released in the spring in fulfillment of DGGS contracts with the federally supported STATEMAP program. We are using the DGGS Geographic Information System (GIS) to generate these maps, and all data for the project will ultimately be stored and made available in a geographically referenced relational database. We hope to be able to serve this data on the World Wide Web upon completion of the project.

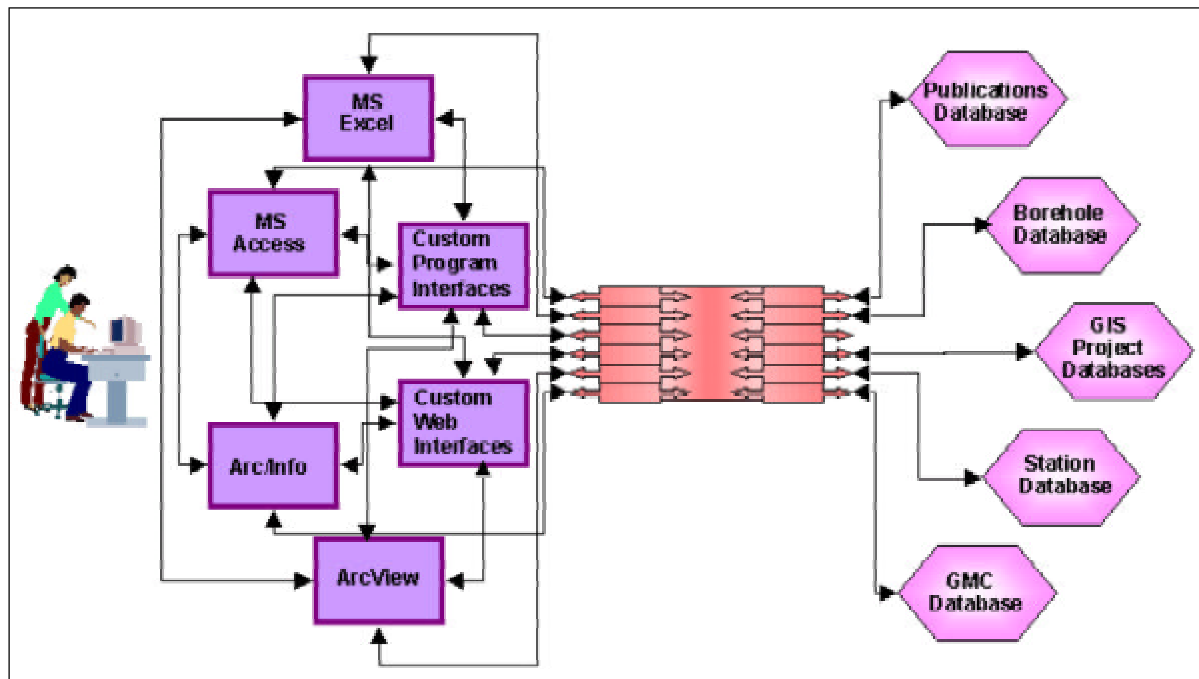


DIGITAL GEOLOGIC DATABASE

Contact: Gail Davidson, *Geologic Communications Section*, (907) 451-5006, gail@dnr.state.ak.us

As part of the Minerals Data and Information Rescue in Alaska (MDIRA) project, an interagency database will be constructed to preserve and provide access to the full range of Alaska's mineral related data. This project encompasses the data and database configuration work required of the Alaska Division of Geological & Geophysical Surveys (DGGS) as part of that larger task. As part of the federally funded MDIRA project, during

mineral-related geologic data that has not yet been gathered into organized data sets. DGGS will assemble the various at-risk geologic data within DGGS, organize these data into rational data sets and link them together in a digital agency-database system. The DGGS system will be designed and implemented in a manner that will provide access to the data for the interagency MDIRA database and web site. During FY01 DGGS will con-



the past three years federal agencies have made a concerted effort to systematically organize their electronic geologic-data files. To ensure the preservation of Alaska minerals-related data that was nearly lost, it must be accessible and used regularly. During the next two years, the MDIRA project is scheduled to design and construct a comprehensive federal-state interagency Alaska geologic-database management and delivery system that will combine new and rescued data and make it widely available over the Internet.

The Alaska Division of Geological & Geophysical Surveys (DGGS) possesses a significant amount of Alaska

struct the database system and load representative data sets to ensure the system meets at least minimum functional criteria. A sophisticated Internet delivery system will require additional work and coordination with the USGS and other interagency participants in the MDIRA program.

The Digital Geologic Database is an ongoing, evolving project. It is a structure beneath the scientific work of DGGS and the products that we provide. With forethought, the Database will be portable as hardware and software systems change over time.

DGGs WEB PAGE

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<http://www.dggs.dnr.state.ak.us>



The DGGs Web page maintained its growth in FY00, with 22,985 visits to our page. Most of these visitors were from industry, with a sizeable portion from government agencies. The most popular parts of the page this year were the *Guide to Alaska Geologic and Mineral Information*; the publications list, searchable by quadrangle; and the GIS map examples. Our access line was upgraded to T-1 to allow faster access to the site.

Many files are available for downloading from the site. In order of popularity, the files downloaded most in 2000 have been MP-32, Seismically Induced Ground-Failure

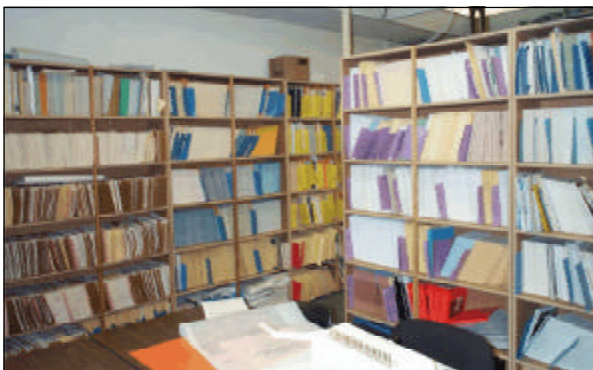
Susceptibility, Anchorage, Alaska; PIR 2000-1, Generalized Geologic Map, Holitna Area, Alaska; PDF 98-37a, Preliminary Geologic Map of the Tanana A-1 and A-2 Quadrangles, Central Alaska; and PDF 96-16, Preliminary Geology of the Fairbanks Mining District.

Future plans for the DGGs Web site include rearranging access to information, adding more geologic maps, continuing to link entries on the bibliographic lists directly to on-line copies of the publications, and making a bibliographic database searchable by many criteria rather than quadrangle only.

SCANNING AND DOCUMENT CONVERSION PROJECT

Contact: Gail Davidson, Geologic Communications Section, (907) 451-5006, gail@dnr.state.ak.us

In the 40 years since statehood, DGGs and its predecessors have published a wealth of geologic research and information about the geology, natural resources, and geologic hazards of Alaska. DGGs also is custodian of the most complete set of research reports from the Alaska Territorial Department of Mines. Except for maps and



reports published in the past few years, all of these publications exist solely on paper. Access to hard-copy publications effectively is limited to patrons of research libraries in Fairbanks, Anchorage, and Juneau, and to persons who purchase publications through the DGGs office in Fairbanks.

Courtesy of a grant from the USGS under the Alaska Minerals Data and Information Rescue Program, DGGs is in the second and final year of a project to convert most past publications and maps to electronic files. These electronic publications will be freely available through DGGs's website (<http://www.dggs.dnr.state.ak.us>).

To date, significant progress has been made in scanning and converting publications—both “text” and oversized sheets such as maps, large data tables, stratigraphic columns, and other large illustrations. The “text” portions of all available DGGs publications (pages of text, tables, and illustrations that are 11 inches by 17 inches or less in size) have been scanned. This body of information comprises 67,000 pages from 1,900 document titles. These publications are in Adobe Acrobat Portable Document Format (PDF), a file format that can be read on almost all computer platforms using free software downloaded from Adobe Systems, Inc.

To date, slightly more than half of the estimated 3,000 oversized sheets have been scanned and converted to a compressed file format accessible from most computer platforms. The compressed format chosen for the maps is MrSID (Multiresolution Seamless Image Database)

from Lizardtech. It uses a wavelet compression technique to achieve 20:1 or higher file compression with virtually undetectable image degradation at 1:1 scale. The advantage of this compression is that it will allow users to download high-quality, full-scale images from the Internet. Similar to the Acrobat PDF format, a free viewer is required to read or print the files, and to extract the compressed image to an uncompressed raster format (TIFF). A growing number of image processing and GIS software programs are able to read and use the compressed files either as a native format or through free plug-ins. More information about MrSID is available on Lizardtech's web site at <http://www.lizardtech.com>.

The current focus of this project is the design and implementation of a web interface, which will allow the public to access these files on the Internet. Initially, this interface will follow the quadrangle-based approach currently in use on the DGGs web page. Links will be established from each publication in the current quadrangle lists to the downloadable files. Users also will be able to locate and download files using the DGGs publication identification number (for example, PDF 88-02).

For the future, DGGs is exploring options for making the files searchable through indexed-term or full text searches, and for enhancing users' ability to query all of the files and retrieve multiple documents on the web site. When this search capability is implemented, it will make DGGs's “virtual library” a truly powerful resource for the 21st century!



ACCOMPLISHMENTS—FY00

DGGS has a mandate to generate new objective peer reviewed knowledge about the geology of Alaska and inventory its resources and geologic hazards. In FY00 the Division successfully pursued several funding avenues to finance field teams to generate new geologic data for North Slope energy projects, geophysical and geological mineral inventory mapping, seismic hazard investigations, and rural energy geologic assessments. DGGS also made good progress in advancing the accessibility of the state's geologic knowledge base through the initiation of a now nearly finished document conversion project.

Last year witnessed great change to the oil-industry environment in Alaska. A series of mergers and announcements of future mergers among the world's major international oil companies fundamentally changed the dynamics of the oil industry as it relates not only to Alaska, but to all of North America. The new megacorporations will achieve economies of scale with respect to production from existing oil fields. However, the impact of the mergers on future exploration for new fields in North America, and specifically in Alaska is uncertain.

Undiscovered onshore and offshore oil fields in the 500 million to billion barrel or larger size range are believed to exist on the North Slope. Strategically, it is important that the remaining oil potential of the North Slope not be ignored. On a state level, the revenues from this oil represent a significant input to the state's long-term economic health. On a national level, the North Slope represents one of few remaining opportunities to maintain a robust, independent, domestic oil industry. If there are not major commitments to exploring frontier areas in Alaska by the megacorporations, the responsibility for finding this oil and developing it defaults to the country's independent oil companies. Many of these companies do not have the cadres of petroleum geologists, geophysicists, tectonic synthesizers, paleontologists, structural geologists, etc., characteristic of the exploration staffs within major oil companies. Even the larger independent companies have a greater need for pertinent public-sector geologic information to establish a coherent geologic framework for their more detailed exploration work.

If Alaska is to enjoy the benefits of a sustained petroleum industry and if the country is to preserve the strategic advantage of a sustained domestic petroleum industry, then a place for the country's domestic oil companies must be created in Alaska. One key factor in

bringing the nation's domestic independent oil companies to Alaska is lowering the geologic risks of doing business here. A second factor is the reintroduction of a more level playing field so that many companies have a justified conviction that they can succeed in a vigorous competition for discovery. Both of these objectives were addressed in the Division's FY00 energy program.

Downsizing of federal and state agencies in Alaska during the late '80s and early '90s placed at risk an extensive body of geologic, geochemical, mineral and mineral-development data that had been collected by federal, state, and private organizations over the past century. The data are archived in various locations offering various levels of storage capacity, quality, and accessibility. The budget exigencies for federal and state archival functions created a need to develop aggressive plans for assembling and maintaining this data legacy. For the purpose of this effort, "at risk data" is defined as data and voucher samples existing in substandard storage sites or a mode in which data may be subject to irretrievable loss or degradation, or may be unavailable to meet the needs of its intended users. A liaison committee comprising representatives from the Alaska Miners Association, Alaska Federation of Natives, University of Alaska, Alaska Department of Natural Resources, and independent mineral consultants has been established to guide the implementation of mineral data rescue efforts.

Work on the Alaska mineral data rescue effort has been widely distributed across the private sector as well as through various state and federal agencies. In FY00, DGGS concentrated on converting all of its existing maps and text publications to digital format so that they can be made available on the Internet. That effort will be completed in FY01. DGGS also employed two University of Alaska student interns to update part of the comprehensive Alaska database of mineral deposits. Our Geologic Materials Center (GMC) core storage facility at Eagle River, Alaska, was expanded by 77,000 cubic feet and its electrical systems, fire safety equipment, earthquake mitigation, and disability access have been brought into compliance with appropriate state and federal codes. Work is being done to put the GMC archive index on the Internet.

In collaboration with the University of Alaska Geophysical Institute, our engineering geologist has completed a series of maps showing seismic groundmotion site response at various shaking frequencies for the city of

Anchorage. These maps were made by combining information derived from an extensive database of borehole geotechnical data and an updated surficial geology map with new strong-motion seismic data recorded at distributed points across the city by the Geophysical Institute. These data produce a model that correlates well with damage resulting from the 1964 Good Friday Earthquake and the three-dimensional distribution of geologic units. Our Engineering Geology Section is also involved with a multi-year tsunami hazards project, building a database of Alaska's Quaternary faults, and continued volcanic hazard mitigation.

DGGS was fortunate in being allowed to continue its airborne geophysical/geological mineral inventory project another year. With state supplemental funding and a cooperative agreement with the U.S. Bureau of Land Management we were able to conduct surveys of two land tracts having a combined area of about 2,000 square miles. The state tract was surveyed with three sensors (aeromagnetic, electromagnetic, and air radiometric). The federally sponsored survey was limited to the collection of aeromagnetic and electromagnetic data. In recent years we have selected high-mineral-potential areas for survey followed by 1:63,360-scale geologic mapping. The geophysical data has allowed us to make greatly improved geologic maps and the combined geologic and geophysical data have contributed significantly to encouraging mineral exploration in the survey tracts.

The following highlights summarize the results of these and other activities conducted during FY00.

- Published Special Report 53 (*Alaska's Mineral Industry 1998*) and Information Circular 46 (*Alaska's Mineral Industry 1999, A Summary*). These publications provide the state's authoritative statistics and other information about the billion-dollar Alaska mineral industry. The reports are widely circulated and used by many exploration managers as an aid in securing funds for Alaska mineral ventures.
- Completed a detailed airborne geophysical survey of 1,032 square miles in the Salcha River–Pogo mining area. Thirty geophysical maps and digital data products were released to the public. In response to public request, air radiometric data in addition to aeromagnetic and airborne electromagnetic data were acquired in this survey. These new geophysical data are encouraging private-sector investment in mineral exploration and development in rural mining districts.
- Completed the 415-square-mile geologic mapping project in the Talkeetna Quadrangle. The project was a one-year field study that provided geologic ground-truth for the FY97 airborne geophysical survey conducted in a portion of the Yentna mining district.
- Released an interim geologic map of a portion of the Fortymile geophysical tract. This interim map summarizes the ground-truth observations made during the first year of a planned three-year geologic ground-truth mapping inventory of the 1,100-square-mile tract. This map is already being used by exploration companies working in the area.
- Completed four mineral deposit data files for the Alaska Resource Data File (ARDF) project, a cooperative program administered by the U.S. Geological Survey. Initiated in 1999, the ARDF project calls on Alaska's entire community of mineral resource experts to build a digital database of all known Alaska mineral occurrences grouped by 1:250,000-scale quadrangle (153 total). DGGS will provide between nine and fifteen completed ARDF quadrangle updates under this multi-year agreement.
- Published an interim geologic map for a portion of the Iron Creek geophysical tract in the Talkeetna Mountains. This map summarizes ground-truth geologic observations needed to effectively interpret the airborne geophysical data acquired for this area in FY98. The map covers the southeast quarter of the Talkeetna B-5 Quadrangle.
- Published a page-sized generalized geologic map of Alaska in both digital and paper formats. This concept map is very popular and has been in great demand at mineral and energy professional meetings, by the Association of American State Geologists, and on the DGGS web site.
- DGGS mineral specialists delivered information about Alaska's mineral potential through oral presentations at eight state, provincial, and international mineral industry and other professional conventions; professional journal articles; newsletters; and by organizing special Alaska mineral deposit theme sessions at Alaska's two primary mining conventions.
- Completed a cooperative DGGS–U.S. Geological Survey STATEMAP geologic framework study of the Sagavanirktok B-1 Quadrangle in the North Slope oil province. The resulting geologic map extends from the Arctic coastal plain to the Brooks

Range foothills. The area comprises surface exposures of rocks that form a link between the geology of the National Petroleum Reserve (NPRA) to the west and the Alaska National Wildlife Refuge (ANWR) to the east. The project area contains part of the Colville Basin wherein rock units in the subsurface form reservoir and source rocks for Prudhoe Bay and satellite fields.

- Initiated a five-year project to evaluate the oil and gas reservoir and source potential of Cretaceous-age rocks exposed in the northern foothills belt of the Brooks Range from the Dalton Highway on the east to the Bering Sea coast on the west. FY00 accomplishments include the publication of a technical report on the petroleum geology of this belt of rocks, and two summaries presented as posters at professional meetings. Knowledge of the framework geology along the foothills belt is catalyzing increased interest in the gas potential of this area.
- Succeeded in soliciting \$125,000 to fund the FY01 field inventory phase of the NPRA–Brooks Range Foothills Project. Program Receipts are required to finance the operational costs of this project. This project supports corporate oil exploration by constructing a regional geologic framework needed to guide more detailed corporate site-specific evaluations.
- Conducted a field trip for industry representatives to key geologic features in the Brooks Range foothills belt. Continuous turnover within corporations, new participants attracted to the North Slope, and a change in the companies involved in North Slope oil and gas exploration results in corporate knowledge attrition and the need for ongoing education of many of the state's new oil explorationists.
- Concluded the Western Arctic Energy (Tingmerkpuuk) project with the publication of a geologic map of the DeLong Mountains D-2 and D-3 quadrangles and four reports on the energy potential in the foothills belt of the Western Arctic Slope.
- Published the results of a survey that identified three areas within Alaska coal basins that have sufficient favorable geologic information to justify further geophysical testing and exploratory drilling for coalbed methane. This is part of a DGGs effort to identify sources of coalbed methane to meet rural Alaska energy needs for heat and power. Wainwright, Fort Yukon, and Chignik all have good potential for developing a local coalbed methane energy source.
- Published a report summarizing the petroleum potential of the Holitna Basin in southwestern Alaska and compiled a detailed bedrock geologic map of the Sleetmute A-2 Quadrangle that will not be released until FY01.
- Conducted a coalbed methane workshop, "Opportunities in Alaska Coalbed Methane." The workshop was co-sponsored by the national Petroleum Technology Transfer Council and the U.S. Geological Survey. Attendees included coalbed methane exploration companies from the Lower 48. There were 110 participants. During the three-day workshop, attendees were given a thorough introduction to the status of coalbed methane development in Alaska and the state's potential for this industry.
- In order to catalyze private-sector interest in Alaska's energy resources, DGGs staff presented new geologic mapping and other geologic framework interpretations at the national American Association of Petroleum Geologists meeting, the Alaska Geological Society Technical Conference, a U.S. Department of Energy (DOE) annual coalbed methane meeting in Washington, PA, and a DOE gas-to-liquids meeting in Anchorage.
- Published a preliminary geologic map and cross sections of central and east Anchorage (PIR 1999-1), based on previous mapping and a newly compiled GIS database of geotechnical borehole logs and water-well data. The map and cross sections provide important information for evaluating earthquake hazards and for better understanding aquifers. The data are being used to develop maps of ground-shaking amplification, seismic soil types, and liquefaction susceptibility.
- Finished compilation of geotechnical-borehole and well-log data for western Anchorage. Although data will continue to be added to the database, this completes the initial compilation and will allow the east-Anchorage geologic map and cross sections to be extended across the entire city, as well as aid in development of new earthquake hazard maps.
- Provided geologic background for an earthquake-response exercise conducted jointly by the Municipality of Anchorage and the U.S. Army Corps of Engineers. DGGs produced maps and ground-shaking estimates for two hypothetical scenario earth-

quakes on which this exercise was based. One was a deep, magnitude 8, subduction earthquake beneath the city of Anchorage, the other was a shallow, crustal earthquake on the Border Ranges fault, which passes through east Anchorage at the base of the Chugach Mountains.

- In cooperation with the Division of Emergency Services and the University of Alaska Geophysical Institute, DGGs initiated a project to develop tsunami hazard maps of communities along the Pacific Ocean coast, starting with Kodiak. Partial funding for the project comes from the National Oceanic and Atmospheric Administration. These maps, to be published by DGGs in FY2001, will depict probable run-up limits of tsunami waves and appropriate evacuation routes so that the people of these communities will know what to expect and be prepared to respond when a tsunami warning is issued.
- Initiated a project to compile all published information on Quaternary-age faults and folds in Alaska (those active in the past 2 million years). The project, which is partially funded by the U.S. Geological Survey, will result in an atlas of these active and potentially active faults and folds, a printed map showing their locations and ages, and a CD-ROM of registered 1:250,000-scale quadrangle maps. The DGGs Report of Investigations will be a useful tool for geoscientists, engineers, emergency managers, government and industry planners, researchers, and educators.
- As part of Anchorage area earthquake-hazards studies, DGGs participated with personnel from the University of Durham (England) to obtain detailed sedimentologic data on land-level changes during the 1964 earthquake and several similar prehistoric earthquakes. Data from this and previous DGGs work has revealed evidence of small pre-earthquake land adjustments that could become a basis for forecasting these major events several months to several years in advance.
- Represented Alaska on the Western States Seismic Policy Council, which provides a forum for communication between geoscience and emergency management professionals and develops policy recommendations for states and local governments to consider in reducing earthquake risks. These policy recommendations may include public education programs, hazard mapping, zoning regulations, building codes, insurance, or emergency-response planning, and are left to the discretion of state and local lawmakers to consider, modify, and implement or disregard as appropriate.
- Participated in the Region III Stream Classification Committee (SCC), an interdisciplinary/interagency group charged by the Board of Forestry to develop a regional waterbody classification system for forest practices purposes in the interior boreal forest. At the request of the Board, compiled an annotated bibliography of literature dealing with the effects of permafrost and silty soils in the context of potential deleterious effects of tree-harvest practices on fish-bearing streams, including an introductory section summarizing the results of the research.
- Published "*Reconnaissance surficial-geologic map of the Sagavanirktok B-1 Quadrangle, eastern North Slope, Alaska*" (Report of Investigations 2000-1c) and "*Reconnaissance engineering-geologic map of the Sagavanirktok B-1 Quadrangle, eastern North Slope, Alaska*" (Report of Investigations 2000-1d). These are surficial-geologic and derivative engineering-geologic maps for the Sagavanirktok B-1 Quadrangle, an area of approximately 267 square miles (685 square kilometers) that is crossed by the Trans-Alaska Pipeline. These maps accompany the general geologic map and will be beneficial for locating construction materials and evaluating engineering constraints for future development in the area.
- Published "*Reconnaissance surficial-geologic map of the Petersville (Yentna) mining district, Alaska*" (Report of Investigations 99-7). This surficial-geologic map of the Petersville mining district covers an area of approximately 428 square miles (1,097 square kilometers) and includes portions of the Talkeetna B-2, B-3, B-4, C-2, and C-3 quadrangles.
- At the request of the Division of Oil and Gas, prepared a geologic-hazards assessment of a proposed oil and gas lease sale in the North Slope Foothills. The report was released as DGGs Miscellaneous Publication 39, "*Geologic hazards in and near proposed State of Alaska oil and gas sale, North Slope Foothills*".
- Completed three weeks of fieldwork in the Fortymile mining district in support of a three-year project to provide ground-truthing for airborne geophysical surveys flown in the area. Our present working hypothesis is that many of the known placer gold deposits in the Fortymile mining dis-

trict were created by modern streams reworking ancient high-level terrace gravels that flank many of the major drainages.

- Provided overall logistical coordination and management for major expansion of Alaska Volcano Observatory (AVO) volcano monitoring capabilities in the eastern Aleutian Islands and on the Alaska Peninsula. Expanded monitoring of active Aleutian volcanoes will ensure accurate and timely reporting of volcanic activity along this major airline and air cargo route. By the end of FY2000, 22 of Alaska's historically active volcanoes (about half of them) were monitored—compared to four that were monitored in FY96.
- Continued maintenance and construction of the *public* AVO World Wide Web pages. These pages were visited by up to 400 people per day during the Pavlof and Okmok eruptions. The purpose of these web pages is to improve public safety by providing access to timely and accurate information for the general public, management agencies, the aviation industry, local communities, and others who may be impacted by the nearby or distant effects of volcanic eruptions.
- Continued maintenance and construction of the *internal* AVO World Wide Web pages. These pages display a wide variety of near-real-time seismic and satellite data. These pages have become instrumental in daily monitoring of volcanoes.
- Responded to 320 requests for technical assistance or information on engineering-geology issues and geologic hazards in Alaska. About one-third of these requests came from state agencies. The remainder came from federal agencies, local government, private businesses, academia, and individuals.
- Funded by the federal Alaska Minerals Data and Information Rescue project, DGGs converted all of the agency's reports and about half of DGGs geologic maps to digital format. These reports and maps will become available via the Internet in FY01.
- DGGs maintained information booths at three in-state and three out-of-state professional conferences to highlight opportunities in Alaska for geologic resource investment and to demonstrate the kinds of information that the Division has available to help people establish geologic resource ventures in Alaska.

- DGGs published the third in a series of scenic calendars for 2000 featuring photos of the Hubbard Glacier in Disenchantment Bay. The calendar includes contact information for DGGs and the address of the Division's web site. The calendars are widely distributed and help a large audience of interested persons, companies, and agencies gain access to information about Alaska's geologic resources and engineering geology information.
- DGGs geologists participated in a variety of education and outreach activities throughout the year. Our staff served as judges at science fairs both locally and at the Statewide High School Science Symposium, prepared mineral collections and activity stations for children participating in Earth Days, participated in elementary school science nights, taught Boy Scouts about geology, gave seminars for University of Alaska geology courses, and served as advisors on University of Alaska graduate student research committees.

Project accomplishments that were not planned at the outset of FY00 but represent achievements made in response to opportunities encountered during the year include the following:

- Contract implementation, scientific oversight, and release to the public of airborne-geophysical data for 605 square miles of prospective mineral terrane on Prince of Wales Island near Ketchikan, Alaska. This cooperative project was funded by the U.S. Bureau of Land Management, the Ketchikan Gateway Borough, Sealaska Corporation, the cities of Thorne Bay and Coffman Cove, and the Alaska Mental Health Trust Land Office. In FY00 60 maps and digital products from this survey were released to the public.
- Contract implementation and scientific oversight for the acquisition of airborne geophysical data for about 1,000 square miles of prospective mineral terrane in the Iditarod–Sleetmute–Aniak region of southwestern Alaska. This cooperative project was funded by the U.S. Bureau of Land Management and managed by DGGs. This project was undertaken to encourage mineral exploration in an area that would benefit from new employment opportunities. Early in FY01, 23 maps and digital products were released from this survey to the public.
- Negotiated for a bedrock geologic map of part of the Delta mining district, a region of volcanogenic massive sulfide and prospective plutonic gold de-

posits in Interior Alaska. Over the past 15 years, private companies spent many millions of dollars in this area on drilling, airborne geophysical surveys, geologic mapping, and geochemical analyses. The result of this work as it pertains to the framework geology of the district is being contributed to the state. These data will be compiled in conformance to DGGs review and publication standards and released to the public in the fall of 2001.

- In response to a request by the Geological Survey of Canada (GSC), DGGs entered into a cooperative agreement to share information and potential fieldwork in the Mt. Hayes Quadrangle of central Alaska. The purpose of this agreement is to increase public understanding of the nickel–copper–platinum group element (Ni–Cu–PGE) potential of central Alaska. The GSC is actively investigating a zone of Ni–Cu–PGE mineralization that extends into Alaska from the Kluane ultramafic belt of Yukon and northern British Columbia. This cooperative agreement will supply Alaska with a detailed geologic map of the belt's most promising mineral potential in the vicinity of Broxson Gulch, Alaska.

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ROGRAM—FY02

The goals of DGGS are closely aligned with those of the Governor, AS 41.08.

The Legislature has directed DGGS to seek the following outcomes:

1. Encourage private-sector investment in ventures that will develop Alaska's mineral, oil and gas, coal, and construction materials.
2. Mitigate the adverse effects of naturally occurring geologic hazards on the economy of Alaska and the safety of Alaskans

DGGS pursues these outcomes through the products and services provided by five major programs. To implement these programs, DGGS pools funds from the Division's annual General Fund base budget, Federal

Receipts, Legislatively Designated Program Receipts, and Capital Improvement Projects. Federal Receipts and Program Receipts are sought only for program activities that are closely aligned with the mission specified in AS 41.08 and the Division's Mission and Measures statement. Likewise, CIP funds address geologic resource problems or goals that DGGS has been specifically asked to pursue. Currently, one-half to three-fifths of Alaska's geophysical and geological program is financed from non base level budget funding sources. Securing the complementary funds required to implement the mandates of AS 41.08 and our Mission Statement on an annual basis is never assured.

The following tasks within our five major programs constitute the Division's strategy for meeting the goals of the DGGS Mission Statement in FY02.

STATEWIDE MINERAL RESOURCE APPRAISAL

- Contingent on FY02 CIP funds, geophysically survey 1,000 square miles (640,000 acres) of high-potential mineral tracts per year to provide the geophysical data needed to sustain Alaska's mineral industry investments and create jobs throughout Alaska.
- Funded by FY02 General Fund base budget, federal grants applied for, and committed airborne geophysical/geological mineral inventory CIP funds, complete ground-truth geologic mapping of the Eagle A-1 Quadrangle. This map will provide ground-truth geologic data needed to more effectively interpret the geophysical data previously generated for the Fortymile mining district airborne geophysical tract. Ground-truth geologic mapping in this area will lead to a much greater understanding of the mineral prospects in the region, and will thus help the mineral industry in

Alaska and aid planning by state and federal agencies. A geologic map, sample location map, and tables of analytical data will be produced.

- Funded by FY02 General Fund base budget and committed airborne geophysical/geological mineral inventory CIP funds, conduct ground-truth geologic mapping and release an interim geologic map of the Big Delta C-3 Quadrangle within the Salcha River–Pogo airborne geophysical tract. This map will provide ground-truth geologic data needed to more effectively interpret the geophysical data previously generated for the Salcha River–Pogo mining district. The mapping area is a key to understanding regional geology near the Pogo mineral deposit and newly discovered Caribou prospect. Conducting investigations and releasing geologic data about this area will help the mineral industry and policy makers make informed decisions. A preliminary geologic map, sample location map, and tables of analytical data will be produced.

- Gather, verify, and collate pertinent statistics and summary observations about the status of Alaska's mineral industry to document the industry's annual achievements and encourage others to participate. This document is widely circulated and is recognized as the best source of summary statistical data on Alaska's mineral industry.



- Provide authoritative briefings about the status of Alaska's mineral industry, State support for mineral ventures, and recently acquired geophysical and geological data at professional mineral industry conventions and trade shows, and in professional journals. These presentations are an effective means of bringing the favorable mineral development potential of Alaska to the attention of corporate exploration managers and others who make mineral industry investment decisions.
- Produce a ground-truth geologic map of the Delta mining belt from data contributed to us by the private sector. Several different companies collected geologic and geochemical data over many years of investigation. Synthesizing and releasing the data to the public at large will add to a better understanding of the geologic framework of Interior Alaska and will encourage mineral investment in the region.
- Contingent on federal funding, begin a two-year project to compile a georeferenced database of geochemical data from past DGGs projects and make this information accessible and searchable on the Internet. Major oxide and trace-element geochemical analyses from bedrock samples and geochemical data from stream-sediment samples will be screened for quality data. The resulting database will include the analytical technique, laboratory, vintage, degree of reliability, and associated project information.
- Contingent on federal funding, compile a GIS-based georeferenced bibliography of bedrock geologic mapping of Alaska showing what geologic mapping is available for the state, its vintage, and degree of reliability. Make this information accessible on the Internet.
- The World Wide Web has become one of the most important avenues for dissemination of information about Alaskan geologic resources. Some of the information that needs to be made available includes mining statistics, status of current geologic field projects, summaries of geophysical survey locations and project information, and an updated GIS-based summary of significant mineral deposits in Alaska. This carefully organized information will be useful to the mineral industry, policy makers, other government agencies, and to the general public.
- Respond to verbal and written requests for information from other State agencies, local government, and the general public.

STATEWIDE ENERGY RESOURCE ASSESSMENT

- Contingent on federal funding, conduct new 1:63,360-scale geologic mapping in the Philip Smith Mountains C-5 Quadrangle and adjacent areas (600 square miles) that contain significant oil and gas reservoir and source rocks; and publish bedrock, interpretive geologic, and geologic materials maps for this area to facilitate oil and gas exploration in the Brooks Range foothills belt.
- Contingent on Legislatively Designated Program Receipts, determine the oil reservoir characteristics of Nanushuk Group and Tuluva Formation sandstones exposed along 120 miles of the northern Brooks Range foothills in order to provide key geologic framework elements to aid future oil exploration in the central North Slope. Evaluate hydrocarbon source rock potential of selected rock units in the southern Colville Basin and northern flank of the Brooks Range to identify favorable oil or gas exploration plays.
- Update and convert to digital format the framework geology encompassed on five conventional paper-based 1:250,000-scale geologic maps (about 30,000 square miles) of the central and western North Slope as an aid to future oil exploration in the National Petroleum Reserve—Alaska and adjacent areas of State lands. Release five maps in digital format and publish hard-copy 1:125,000-scale geologic maps for two quadrangles.
- Funded by FY01 CIP funds, complete and publish gas potential assessment for the Holitna basin including coalbed methane evaluation of surface coal exposures, reinterpretation of high-resolution aeromagnetic survey data and reinterpretation of a commercial, high-resolution gravity survey to better delineate the deep structure of the Holitna basin.
- Contingent on federal funding, initiate a three-year program to develop lightweight coiled-tubing microborehole drilling technology to test coalbed methane potential and gas producibility at three high-priority rural Alaska sites.



- Contingent on federal funding, acquire new geochemical data for coal in the Kobuk River Basin in order to classify that coal resource's quality in support of future coal prospecting, leasing, and coalbed methane leasing.
- Contingent on pending federal funding, conduct a basinwide energy-resource assessment of the Yukon Flats to contribute oil, conventional gas, and coalbed gas to domestic markets through existing and proposed pipelines.
- Produce written evaluations of minable coal potential for lease areas in response to requests from Division of Mining, Land and Water Management.
- Respond to verbal requests from other State agencies, federal agencies, industry, local government, and the public for information on energy-related geologic framework and oil, gas, and coal resource data (estimated 80 responses).

STATEWIDE ENGINEERING GEOLOGY/CONSTRUCTION MATERIALS

- Contingent on partial federal funding, complete maps of seismic soil types and earthquake-induced liquefaction susceptibility in the Anchorage area that will be used in conjunction with local building codes for earthquake-resistant planning, design, and construction.
- Contingent on partial federal funding and in cooperation with the Division of Emergency Services, University of Alaska Geophysical Institute, and coastal communities, publish tsunami-inundation maps for one or two coastal communities (maps for Kodiak will be completed in FY 2001).
- Supported by federal funding through the Coastal Management Enhancement Grants Program, publish generalized earthquake ground-shaking hazard maps for southwestern and southcentral coastal districts.
- Produce written evaluations of potential hazards in areas of oil exploration leases, land disposals, permit applications, coastal management reviews, etc., and respond to verbal requests for information from other State agencies, local government, and the general public (estimated 60–70 responses).
- Conduct post-event hazard evaluations in response to unexpected major geologic events (for example, earthquakes, volcanic eruptions, and landslides), providing timely information dispersal to the public via electronic as well as traditional methods, and providing event and continuing hazard information to appropriate emergency management agencies.
- Contingent on continued federal funding, publish a geologic map of Mt. Douglas volcano.
- Contingent on continued federal funding, publish an interim geologic and geologic hazards map of Mt. Veniaminof volcano—Alaska's biggest volcano, and one of the most poorly known. This will be the first year of a planned two-year project.
- Contingent on continued federal funding, maintain and enhance the AVO web site. With as many as 400



visitors per day, the AVO web site is one of our most important information dissemination activities.

- Publish a CD-ROM containing geographical, geophysical, geological, geochemical, and land management data for the entire Aleutian volcanic arc in a georeferenced database format.
- Provide final oversight, coordination, and helicopter contracting for multi-team fieldwork to conduct geologic-hazards studies and seismic monitoring of active volcanoes in the Cook Inlet, Alaska Peninsula, and Aleutian Islands regions.
- Participate in volcano eruption response and hazard mitigation as needed to provide timely and accurate warnings and eruption information to emergency-response agencies and air-traffic controllers.
- In support of the Statewide Mineral Appraisal Program, publish ground-truth surficial-geologic and engineering-geologic mapping of up to 500 square miles (320,000 acres) of high-potential mineral tracts to produce the geologic data needed to assess the placer-mineral resources, construction-materials resources, and potential geologic hazards that may af-

fect development of Alaska's mineral industry in selected areas.

- Maintain and update the digital, GIS-based directory of construction-materials producers in Alaska, including location, commodity, and production data.

- Update and expand the existing bibliography and index of surficial-geologic mapping in Alaska, convert it into digital form using GIS, and publish the data digitally via internet and CD-ROM to document the extent of mapping in Alaska, including scale, dates, and bibliographic information, and make the information available to the public.

GEOLOGIC MAPS AND REPORTS

- Assemble and edit the technical and educational maps and reports of DGGS in both conventional and digital format.
- Design and construct a Division-wide digital geologic database management system so that DGGS can improve its cycle time for responding to geologic resource and engineering geology queries and for com-

pleting its mineral and energy inventory studies in frontier areas.

- Assemble, edit, and publish the *Alaska's Mineral Industry 2000* report. This report preserves the definitive statistics for Alaska's mineral industry.
- Maintain the DGGS information management micro-computer network infrastructure.

GEOLOGIC MATERIALS CENTER

- Maintain the state's interagency archive of geologic materials (voucher samples of rocks, oil and gas well processed samples, core, rock, thin-sections, ore samples, and hard-rock mineral core) acquired from private companies and state and federal agencies.
- Acquire and archive new geologic material pertinent to Alaska's energy and mineral resource development as they are donated to the Geologic Materials Center.

- Install an updated GMC sample database on the World Wide Web so that the catalog of the Center's holdings is accessible to mineral and energy explorationists and other interested parties via the Internet.



PUBLICATIONS RELEASED TO DATE IN FY01

Geophysical Reports

GPR 2000-25. Total magnetic field of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Topography included. Full-color plot from electronic file, 600 dpi. Made on request. \$26.

GPR 2000-26. Total magnetic field of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Magnetic contours and section lines included. Full-color plot from electronic file, 600 dpi. Made on request. \$26.

GPR 2000-27. Color shadow magnetic map of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Full-color plot from electronic file, 600 dpi. Made on request. \$26.

GPR 2000-28. Total magnetic field and electromagnetic anomalies of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Magnetic contours and section lines included. Diazo. Made on request. \$50.

GPR 2000-29. Total magnetic field and electromagnetic anomalies of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Magnetic contours, simplified electromagnetic anomalies, and section lines included. Blueline. \$6.

GPR 2000-30A. Total magnetic field and detailed electromagnetic anomalies of parts of the Aniak and Iditarod mining districts, southwestern Alaska (parts of Iditarod B-5 and B-6 quadrangles), by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 1 sheet, scale 1:31,680. Magnetic contours, detailed electromagnetic anomalies, and section lines included. Blueline. \$3.

GPR 2000-30B. Total magnetic field and detailed electromagnetic anomalies of parts of the Aniak and Iditarod mining districts, southwestern Alaska (parts of Iditarod B-4 and B-5 quadrangles), by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 1 sheet, scale 1:31,680. Magnetic contours, detailed electromagnetic anomalies, and section lines included. Blueline. \$3.

GPR 2000-30C. Total magnetic field and detailed electromagnetic anomalies of parts of the Aniak and Iditarod

mining districts, southwestern Alaska (parts of Iditarod A-5 and A-6 quadrangles), by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 1 sheet, scale 1:31,680. Magnetic contours, detailed electromagnetic anomalies, and section lines included. Blueline. \$3.

GPR 2000-30D. Total magnetic field and detailed electromagnetic anomalies of parts of the Aniak and Iditarod mining districts, southwestern Alaska (parts of Iditarod A-4 and A-5 quadrangles), by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 1 sheet, scale 1:31,680. Magnetic contours, detailed electromagnetic anomalies, and section lines included. Blueline. \$3.

GPR 2000-30E. Total magnetic field and detailed electromagnetic anomalies of parts of the Aniak and Iditarod mining districts, southwestern Alaska (part of Sleetmute D-7 Quadrangle), by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 1 sheet, scale 1:31,680. Magnetic contours, detailed electromagnetic anomalies, and section lines included. Blueline. \$3.

GPR 2000-30F. Total magnetic field and detailed electromagnetic anomalies of parts of the Aniak and Iditarod mining districts, southwestern Alaska (part of Sleetmute D-6 Quadrangle), by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 1 sheet, scale 1:31,680. Magnetic contours, detailed electromagnetic anomalies, and section lines included. Blueline. \$3.

GPR 2000-30G. Total magnetic field and detailed electromagnetic anomalies of parts of the Aniak and Iditarod mining districts, southwestern Alaska (part of Sleetmute C-7 Quadrangle), by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 1 sheet, scale 1:31,680. Magnetic contours, detailed electromagnetic anomalies, and section lines included. Blueline. \$3.

GPR 2000-30H. Total magnetic field and detailed electromagnetic anomalies of parts of the Aniak and Iditarod mining districts, southwestern Alaska (part of Sleetmute C-6 Quadrangle), by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 1 sheet, scale 1:31,680. Magnetic contours, detailed electromagnetic anomalies, and section lines included. Blueline. \$3.

GPR 2000-31. 7200 Hz coplanar resistivity of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Topography included. Full-color plot from electronic file, 600 dpi. Made on request. \$26.

GPR 2000-32. 7200 Hz coplanar resistivity of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Resistivity contours and section lines included. Full-color plot from electronic file, 600 dpi. Made on request. \$26.

GPR 2000-33. 7200 Hz coplanar resistivity of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Resistivity contours and section lines included. Blueline. \$6.

GPR 2000-34. 900 Hz coplanar resistivity of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Topography included. Full-color plot from electronic file, 600 dpi. Made on request. \$26.

GPR 2000-35. 900 Hz coplanar resistivity of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Resistivity contours and section lines included. Full-color plot from electronic file, 600 dpi. Made on request. \$26.

GPR 2000-36. 900 Hz coplanar resistivity of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro

Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Resistivity contours and section lines included. Blueline. \$6.

GPR 2000-37. Flight lines of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000, 2 sheets, scale 1:63,360. Topography included. Blueline. \$6.

GPR 2000-38. Set of 2 CD-ROMs containing profile data, gridded data, vector data, and location information of 2000 geophysical survey data for parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000. Gridded data in Geosoft and ASCII format. Vector data consists of data contour lines and is in dxf format. \$40.

GPR 2000-39. CD-ROM containing gridded data, vector data, and location information of 2000 geophysical survey data for parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, Stevens Exploration, and Fugro Airborne Surveys, 2000. Gridded data in Geosoft and ASCII format. Vector data consists of data contour lines and is in dxf format. \$20.

GPR 2000-41. Portfolio of aeromagnetic and resistivity maps of parts of the Aniak and Iditarod mining districts, southwestern Alaska, by L.E. Burns, 2000, 18 p. Includes color and shadow maps. Maps fit 8½" x 11" sheet. \$18.

Professional Reports

PR 119. Short notes on Alaska geology 1999, by D.S. Pinney and P.K. Davis, 2000, 154 p. \$9.

- a. The Soda Creek Limestone, a new upper Lower Devonian formation in the Medfra Quadrangle, west-central Alaska, by R.B. Blodgett, D.M. Rohr, E.A. Measures, N.M. Savage, A.E.H. Pedder, and R.W. Chalmers
- b. Duplex structure and Paleocene displacement of the Toyuk thrust zone near the Dalton Highway, north-central Brooks Range, by R.M. Chmielowski, W.K. Wallace, and P.B. O'Sullivan
- c. Borehole breakouts and implications for regional *in situ* stress patterns of the northeastern North Slope, Alaska, by C.L. Hanks, M. Parker, and E.B. Jemison
- d. Measured section and interpretation of the Tingmerkpuk sandstone (Neocomian), northwestern DeLong Mountains, western Arctic Slope, Alaska, by D.L. LePain, K.E. Adams, and C.G. Mull
- e. Stratigraphic architecture of the Upper Jurassic–Lower Cretaceous Nutzotin Mountains sequence, Nutzotin and Mentasta mountains, Alaska, by J.D. Manuszak and K.D. Ridgway

- f. Stratigraphy, depositional systems, and age of the Tertiary White Mountain basin, Denali fault system, southwestern Alaska, by K.D. Ridgway, J.M. Trop, and A.R. Sweet
- g. Late Devonian (early Frasnian) conodonts from Denali National Park, Alaska, by N.M. Savage, R.B. Blodgett, and P.F. Brease
- h. Geology and gold mineralization at the Donlin Creek prospects, southwestern Alaska, by D.J. Szumigala, S.P. Dodd, and A. Arribas, Jr.
- i. Preliminary $^{40}\text{Ar}/^{39}\text{Ar}$ ages from two units in the Usibelli Group, Healy, Alaska: New light on some old problems, by D.M. Triplehorn, J. Drake, and P.W. Layer
- j. Sedimentology and provenance of the Paleocene–Eocene Arkose Ridge Formation, Cook Inlet–Matanuska Valley forearc basin, southern Alaska, by J.M. Trop and K.D. Ridgway
- k. Late Devonian (Late Famennian) radiolarians from the Chulitna Terrane, south-central Alaska, by M.Z. Won, R.B. Blodgett, K.H. Clautice, and R.J. Newberry

Raw-Data File

RDF 2000-4. Major oxide, minor oxide, trace element, rare-earth element, and geochemical data from rocks collected in Eagle and Tanacross quadrangles, Alaska in 2000, by M.B. Werdon, D.J. Szumigala, R.J. Newberry, J.C. Grady, and W.C. Munly, 2000, 27 p., 3 sheets, scale 1:63,360. \$42.

Reports of Investigations

RI 2000-2. Geologic map of the Coke Basin-Kukpowruk River area, DeLong Mountains D-2 and D-3 quadrangles, Alaska, by C.G. Mull, E.E. Harris, R.R. Reifenstuhl, and T.E. Moore, 1 sheet, scale 1:63,360. \$13.

RI 2000-3. Interpretive bedrock-geologic map of the Petersville (Yentna) mining district, Alaska, by D.J.

Szumigala, D.S. Pinney, D.L. LePain, S.A. Liss, L.E. Burns, K.H. Clautice, J.L. Mayer, and A.M. McCarthy, 1 sheet, scale 1:63,360. \$13.

RI 2000-4. Preliminary volcano-hazard assessment for Makushin Volcano, Alaska, by J.E. Begét, C.J. Nye, and K.W. Bean, 2000, 22 p., 1 sheet, scale 1:100,000. \$16.

Special Reports

SR 54. Alaska's mineral industry 1999, by R.C. Swainbank, D.J. Szumigala, M.W. Henning, and F.M. Pillifant, 2000, 73 p. Free.

